US Army Corps
of Engineers
Kansas City District

Engineering Division
Hydrologic Engineering Branch
Water Management Section

Annual Report of Reservoir Regulation Activities

Summary for 2011 - 2012

January 2013

NORTHWESTERN DIVISION, KANSAS CITY DISTRICT
SUMMARY OF LAKE REGULATION ACTIVITIES
AUGUST 1, 2011 TO DECEMBER 31, 2012

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PURPOSE AND SCOPE.

This report summarizes the past year's regulation activities at storage projects within the boundaries of the Kansas City District (District) that are operated for flood control by the Water Management Section staff. It also summarizes major work items affecting the projects, and it outlines briefly the programs ongoing or proposed for the year ahead. Topics discussed in the report include recent weather patterns, project accomplishments, current project operations; major regulation problems and proposed solutions; lake regulation manuals; data collection programs and procedures; ongoing studies, and personnel of the Water Management Section. The reporting period for Water Management Section activities covers the operating year from August 1, 2011, through December 31, 2012, with additional discussion on proposed operations and studies programmed through calendar year 2013. Preparation of this report is in conformance with paragraph 13b of ER 1110-2-240, dated October 8, 1982.

LAKES IN THE KANSAS CITY DISTRICT.

The Kansas City District includes the watershed of the Missouri River from Rulo, Nebraska, (river mile 498.1 above the mouth) to the junction of the Missouri and Mississippi Rivers near St. Louis, Missouri. During the period covered by this report, 29 storage projects, at which the Corps of Engineers (Corps) has either complete or partial water control responsibilities, were in operation within the District. There are 18 Corps of Engineers lakes and 11 Bureau of Reclamation lakes. The location of each lake and reservoir in the District is shown on ***Plate 1***, and a summary of engineering data outlining the physical characteristics of each project is included as ***Plates 2A through 2E***.

PROJECT FUNCTIONS AND GENERAL PLAN.

Functions served by storage facilities in the Kansas City District include: flood control, irrigation, water supply, low flow and navigation supplementation, water quality, hydropower, recreation, and fish and wildlife. Most functions except flood control are normally provided through the regulation of storage contained in the multipurpose pool. Releases from multipurpose storage are controlled by the manipulation of gates or other means in accordance with plans, schedules, and ratings prepared in advance to meet various conditions of inflow and demand. The general plan for regulation of flood control storage is to evacuate all accumulations in the flood control space as rapidly as downstream channel capacities and flow conditions permit. Should the top of the flood pool be exceeded, criteria have been developed for each project that schedule releases with an aim toward safeguarding the structure. Downstream interests are warned of the possibility of flooding should a surcharge operation appear likely. Although the storage space in the flood control pool is normally evacuated as quickly as downstream conditions allow, release schedules may be modified at times to serve beneficial purposes such as fish and wildlife enhancement.

CLIMATOLOGIC AND HYDROLOGIC CONDITIONS.

August 1, 2011 through December 31, 2012

Summer 2011

The late summer of 2011 can be characterized as above-normal temperatures and near-normal precipitation for most of the Kansas City District. Temperatures averaged about 2.8 degrees above normal. The summer of 2011 ranked as the 46 wettest out of 123 years of record at Kansas City.

Autumn 2011

In the Autumn precipitation fell off across most of the basin, while temperatures remained near-normal. Precipitation across Kansas and Missouri was 2-4 inches below normal, setting up most of the basin for a dry winter.

Winter 2011-2012

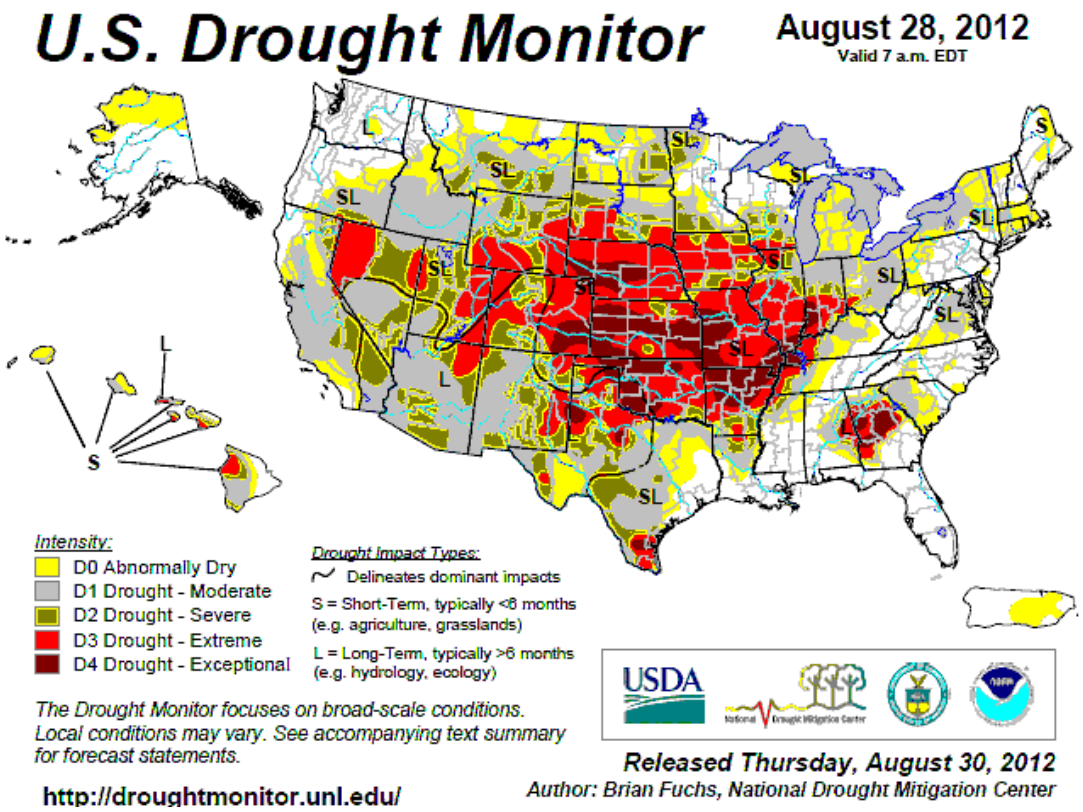
The winter of 2011-2012 was the 7th warmest on record for the lower Missouri basin. Daily highs averaged 4-6 degrees above normal across the basin. Precipitation was above normal; however snowfall was much below normal. Kansas City recorded the 5th least snowiest winter in the 124 year history of observations.

Spring 2012

The spring of 2012 brought record breaking high temperatures with below normal precipitation. Daily highs averaged 7-9 degrees above normal. In Kansas City the last sub-freezing day of the season occurred on March 10th, which is the earliest date in recorded history. Drought conditions began setting in as the District recorded only 2/3 of normal precipitation.

Summer 2012

The summer of 2012 was characterized by exceptional drought along with record high temperatures across the Kansas City District. At the District office in Kansas City, a total of 26 days recorded high temperatures in excess of 100 degrees. August precipitation was skewed by the 2.85 inches that fell on the 31st from the remnants of Hurricane Isaac. Without this unexpected precipitation windfall, the total for the three summer months would have been a mere 3.99 inches. By late August drought conditions in the middle of America had reached level D4:



Autumn 2012

The autumn of 2012 brought near-normal temperatures across most of the Kansas City District. The average temperature was less than a degree above the 30-year norm. The exceptional drought continued, however. Kansas City ended 2012 with precipitation 1.5 feet below normal.

PROJECT ACCOMPLISHMENTS.

Operating purposes at storage projects in the Kansas City District include flood control, irrigation, water supply, low flow and navigation supplementation, water quality, hydropower, recreation, and fish and wildlife. Project accomplishments in each of these functional areas, for the period covered by this report, are described briefly in the following subparagraphs.

Flood Control.

Table 1: Flood Reduction Benefits
(Thousand Dollars)

Project	Fiscal Year 2012	Cumulative
Clinton Lake, KS	$2.9	$1,209,542.5
Harlan County Lake, NE	$11.4	$228,586.1
Harry S Truman Resv., MO	$0.0	$1,870,150.9
Hillsdale Lake, KS	$129.2	$33,538.7
Kanopolis Lake, KS	$10.8	$1,647,023.6
Little Blue River Lakes, MO	$0	$50,813.0
Long Branch Lake, MO	$0.0	$50,229.0
Melvern Lake, KS	$195.8	$220,637.4
Milford Lake, KS	$25.2	$1,316,850.1
Perry Lake, KS	$20.1	$5,438,832.3
Pomme De Terre Lake, MO	$0.0	$69,169.6
Pomona Lake, KS	$0.0	$210,026.4
Rathbun Lake, IA	$0.0	$158,985.8
Smithville Lake, MO	$23.5	$970,247.1
Stockton Lake, MO	$0.0	$206,831.2
Tuttle Creek Lake, KS	$332.8	$6,553,662.3
Wilson Lake, KS	$2.5	$1,573,240.4
TOTALS	**$754.1**	**$21,808,366.4**

Stream flow regulation by storage projects in the Kansas City District began with the closure of Kanopolis Lake in February 1948. By July of that year, Kanopolis also provided the first flood control storage, benefiting downstream damage centers. Since then, stream flow regulation by District projects has produced flood reduction benefits estimated in the millions of dollars annually. In addition to the Corps of Engineers lake projects, local protection projects in the form of levees, floodwalls, and channel improvements also have provided flood reduction benefits amounting to millions of dollars. Federal and private agricultural levees along with temporary storage of flood flows in the main stem reservoir system above Sioux City provide additional benefits within the District. During the reporting period, all of the District lakes stored water in the flood control pools. Flood reduction benefits during Fiscal Year (FY) 2012 credited to all Corps lake projects in the District were $754,100. During the same period, benefits credited to Section 7 Bureau of Reclamation projects within the District totaled $28,400. The accumulated total of flood control benefits for Bureau projects within the District totaled $1,837,859,800. The upstream main-stem projects are responsible for additional flood damage reductions along the Missouri River within the Kansas City District reach. A compilation of flood reduction benefits at Corps Lakes in the District is shown in ***Table 1*** above. The majority of the period flood reduction benefits were incurred in the Osage River basin during March and May, 2012.

Irrigation.

The 2011 crop yields on lands receiving project water in the Nebraska-Kansas Projects were slightly higher than 2010. The average corn yield, the principal crop of all reporting districts, was 170 bushels per acre. This was approximately 7 bushels per acre more than in 2010. The start of irrigation releases from project reservoirs varied considerably but was generally near normal. Above normal rainfall was experienced during much of the growing season with a few exceptions. Temperatures averaged above normal during the season. Crop maturity progressed near normal during the growing season. Most irrigation districts had finished with irrigation releases by early September and all irrigation districts had finished delivering water by the end of September. Corn harvest generally commenced in late October and concluded in November. Only two canals did not divert water in 2011 as a result of short water supplies.

The State of Colorado makes Bonny Reservoir storage water available to Hale Ditch and other natural flow appropriators under short-term water service contracts. Most of the 700 acres served by Hale Ditch are now owned and operated by the Division of Wildlife. During the reporting period, the Colorado Water Commissioner did not direct that reservoir inflows from the South Fork of the Republican River and Landsman Creek be passed through Bonny Reservoir into Hale Ditch. As directed by the Colorado State Water Commissioner, a release was made into Hale Ditch beginning on September 23 and ending on October 9. A total of 272 AF was released into Hale Ditch during 2011.

Municipal and Industrial Water Supply and Water Quality Control.

Three municipalities and one rural water district have executed water service contracts for full or supplemental water supplies from three Reclamation reservoirs. A contract with the city of Norton, Kansas, provides for a maximum annual usage of 1,600 AF from Keith Sebelius Lake (Norton Dam). A contract with Beloit, Kansas, provides for a maximum annual usage of 2,000 AF from Waconda Lake. Waconda Lake also provides up to 1,009 AF of water for a contract with the Mitchell County Rural Water District No. 2. Based on the current State of Kansas Certificate of Appropriation, water usage is not to exceed 737 AF per calendar year. A contract with the City of Russell, Kansas, provides for a maximum annual usage of 2,000 AF from Cedar Bluff Reservoir.

During calendar year 2011, the City of Norton used 339 AF of storage from Keith Sebelius Lake for municipal purposes. Storage releases made from Waconda Lake for the city of Beloit totaled 0 AF, with 0 AF bypassed for downstream water quality control as directed by the State Water Commissioner. Releases of 655 AF were made to the Mitchell County Rural Water District No. 2 from Waconda Lake. No water was released from Cedar Bluff Reservoir during 2009 for the City of Russell. The State of Kansas took 0 AF of water for the fish hatchery downstream of Cedar Bluff Dam.

Twenty three water supply contracts exist between the Corps of Engineers and the State Agencies at 14 lakes, for lake storage space, annual withdrawals, or surplus water. Contracts exist with eleven other municipalities and rural water districts within Kansas, Missouri, and Iowa. The State of Kansas in turn contracts with a large number of municipalities and industrial sites to supply water from the State's contracted storage space through the water assurance and water marketing programs. To date, assurance districts have been formed for users along the lower Smoky Hill River, lower Kansas River and the State of Kansas portion of the Marais des Cygnes River.

Water is supplied within the limits of each contract through designated lake releases or from intakes located on the lake at the following projects: Kanopolis, Milford, Tuttle Creek, Perry, Clinton, Melvern, Pomona, Hillsdale, Smithville, Longview, Rathbun, Long Branch, Stockton, and Harry S Truman.

Recommendations for minimum stream flows to benefit stream sanitation and for the maintenance of desirable water quality standards were originally established by the U.S. Public

Health Service for many river reaches below proposed dams in the District. These recommendations were then utilized to establish minimum release requirements for many of the District lake projects. The minimum release standards set by the Corps water control plans are usually less than the minimum desirable stream flows set by state water authorities. The latter are intended to satisfy water right holders and fish and wildlife flow standards. In some cases, specific water quality storage allocations were included in the project planning to increase the reliability of the minimum flow releases. Depending on the project, the minimum release quantities may be constant through the year, or they may vary seasonally or vary depending on the amount of current lake storage. Minimum releases for the purposes of downstream quality control and stream sanitation range from 3 cfs during the winter months at Hillsdale Lake to 100 cfs at Tuttle Creek Lake. Seepage is generally considered sufficient to meet minimum flow requirements downstream of the Reclamation dams. Additional releases are made from Tuttle Creek, Milford, and Perry Lakes for water quality and water supply purposes during periods of low flow on the Kansas River. Releases from any lake may be reduced below minimum requirements for brief periods due to construction, periodic inspections, or emergencies.

Navigation.

Releases from the Missouri River main stem reservoir system are designed to provide equitable service to navigation and other project purposes, while at the same time recognizing the important flood control functions of the system. Navigation on the Missouri is limited to the ice-free season, with a full season normally extending from April 1 to December 1 at the mouth. Operating experience plus numerous studies have indicated that flows of 35,000 cfs at Kansas City are the minimum that will permit navigation. Groundings can occur with flows of that magnitude, and dredging may be needed to alleviate local problems. Therefore, an additional flow of 6,000 cfs above the minimum service target has been set as the "full service" level for the navigation function. Thus, a full-service target flow of 41,000 cfs at Kansas City is considered adequate to maintain the designed 9-foot by 300-foot channel with little or no dredging. Milford, Tuttle Creek and Perry lakes are at times called upon to supplement Missouri River flows below Kansas City in order to meet the navigation requirement and to conserve water in the main stem lakes.

On July 9, 2012 the Reservoir Control Center requested supplemental releases for navigation support. Supplemental navigation releases ended on August 5, 2012. A total of 115,484 ac-ft of water was released for supplemental navigation support. The navigation season ended at the Kansas City reach on December 7, 2012.

Hydropower.

Hydropower is generated at two Kansas City District projects. Stockton Dam has one unit with a nameplate rated capacity of 45 megawatts (MW), and an overload generation rate of 52 MW. Harry S Truman Dam has six units with a total nameplate rated capacity of 160 MW, and an overload generation rate of 180 MW. The Southwestern Power Administration markets power from Stockton and Harry S Truman projects.

On February 5, 2009, the Stockton turbine experienced a catastrophic failure in the form of a broken blade. In September 2010, temporary repairs were completed and the unit was returned to service. Under a contract funded by ARRA, the Stockton power plant is receiving a total rehabilitation. Stockton's power operation continues to be restricted by downstream channel capacities that limit tailwater elevations to 777.0 feet above mean sea level (msl) and Highway "J" stages to a maximum reading of 17.5 feet. Generation by the Stockton plant during this report period totaled 21,835 megawatt hours (MWH).

Generation by the Harry S Truman plant totaled 137,159 MWH during the period of this report. Power generation releases at Harry S Truman are restricted to four units during the week and three units on weekends between Memorial Day and Labor Day by the Consensus Plan. During the period December 1 to March 1, five units may be operated during the weekdays (total time limited to 600 hours per year) and three units on weekends. The tailwater elevation measured at the Highway 7 Bridge in Warsaw is limited to 662.5 feet msl, Union Electric datum, during five-unit releases from the power pool. Flood control releases are made through the generation units as much as possible. When Truman pool level is above 710.0 feet msl, a minimum of one unit is operated continuously. The Consensus Plan for Truman was negotiated and approved between the Corps, the State, and the Southwestern Power Administration, and became effective March 1990.

Fish and Wildlife.

Water level management plans, which include the fluctuation of pool levels at various times of the year for the enhancement of fish and migrating waterfowl, were in effect during the report period at the following Kansas City District lakes: Smithville, Clinton, Hillsdale, Kanopolis, Melvern, Wilson, Pomme de Terre, Perry, Pomona, Milford, Tuttle Creek, Rathbun, Stockton, and Long Branch. Truman Lake makes releases for the downstream spring fish spawn when water is available, in accordance with an agreement with Southwest Power Administration and the State of Missouri.

Recreation.

Recreational use of the Corps lakes is a highly visible and important function. Recreational use is enhanced when the lakes are operated close to their normal or multipurpose pool levels. During flood years when large quantities of water are stored in the flood pools and during drought years when the lake levels drop, then access to the lakes and the shoreline facilities, as well as the quality of the experience, is reduced. Park managers at the projects are also concerned about related factors such as facility maintenance and water quality. The fish and wildlife function is closely related to the recreation experience, and coordination with

Table 2: Visitation Hours
For Reporting Period

Project	Visitation (Visitor Hours)
Clinton Lake, KS	8,915,999
Harlan County Lake, NE	9,013,566
Harry S Truman Resv., MO	17,929,565
Hillsdale Lake, KS	1,073,052
Kanopolis Lake, KS	1,614,039
Long Branch Lake, MO	2,015,229
Longview/Blue Springs MO	2,687,091
Melvern Lake, KS	7,507,345
Milford Lake, KS	8,371,766
Perry Lake, KS	6,083,578
Pomme de Terre Lake, MO	14,082,974
Pomona Lake, KS	3,371,446
Rathbun Lake, IA	7,049,884
Smithville Lake, MO	8,580,552
Stockton Lake, MO	8,562,376
Tuttle Creek Lake, KS	1,990,305
Wilson Lake, KS	2,144,615
TOTALS	**110,993,382**

state and county park officials for park management is important. A list by projects of the visitation totals at Corps lakes is shown in ***Table 2***. Park visitation was up 6% over the previous flood-shortened year. Project park facilities at Blue Springs, Hillsdale, Long Branch, Longview, and Smithville are leased to county or state agencies.

PROJECT OPERATIONS.

Corps of Engineer Lakes - August 1, 2011 through December 31, 2012.

Flood Pool Storage. During the reporting period there were no prolonged flood-fighting activities at any District lake. All of the District's 18 lakes stored at least a little water in their flood control pools. The maximum encroachment into exclusive flood control space was 6.38 feet above multipurpose level (13% of FCP) at Pomme de Terre Lake on 2 May 2012. All Corps lakes within the Kansas City District were regulated in accordance with normal procedures during the period covered by this report. New record low pool elevations were recorded at Longview and Bonny reservoirs. Details regarding the regulation of all projects are included, along with pool elevation hydrographs, in Appendix A of this report.

Deviations. No deviations from the water control manuals were required during the reporting period.

Tuttle Creek Water Quality Releases. On October 15, 2012 Tuttle Creek Lake dropped below elevation 1065 for the first time since 1967. As specified in the 1995 agreement with the state of Kansas, Tuttle Creek Lake is considered a drought indicator. A water quality target of 600 cfs at Topeka and 700 cfs at DeSoto, for pool elevations below 1065, was established in 1995. These targets were put into effect for the first time on October 15, 2012. Water quality support was also obtained from Milford and Perry lakes. Releases from the three lakes were balanced based on probability of refill.

Blue Green Algae. In the summer of 2012 no releases were made because of blue green algae.

Bureau of Reclamation Projects – 2011 Water Year.

1. Reclamation Conservation Operations. Bonny, Enders, Webster, and Cedar Bluff Reservoirs along with Swanson Lake had inflows between the dry-year and normal-year forecasts. Kirwin, Hugh Butler, Harry Strunk, Keith Sebelius, Waconda, and Harlan County Lakes had inflows between the normal-year and wet-year forecasts. Lovewell Reservoir had inflows above the wet-year forecast. Most of the reservoirs had below average carryover storage from the 2010 water year. Reservoir releases were made from Medicine Creek, Harlan County, Kirwin, and Glen Elder Dams to maintain or reduce reservoir levels prior to the 2011 irrigation season. Just prior to the irrigation season, Enders, Keith Sebelius, Swanson, and Hugh Butler Lakes, did not have sufficient storage to provide water users with a full water supply. Harry Strunk, Harlan County, and Waconda Lakes and Lovewell, and Kirwin Reservoirs had some flood storage occupied prior to the irrigation season.

Irrigation demands only minimally reduced storage in these project reservoirs as early summer inflows maintained the reservoir pools. Reservoir storage was near normal at the end of 2011. On September 20, 2011, the State of Colorado ordered that Bonny Reservoir be drained for Republican River Compact Compliance. The conservation pool was essentially empty by the end of December. The order currently remains in effect and inflows continue to be bypassed. Hugh Butler Lake continues to be maintained near the dead pool level due to the embankment cracking discovered in 2009. Safety of dam work began at this facility in 2011 and is expected to continue through the fall of 2013.

2. Reclamation Flood Control Operations. Harry Strunk, Harlan County, and Waconda Lakes, and Lovewell, and Kirwin Reservoirs utilized flood pool storage and made flood releases in 2011. The water year 2011 flood damages prevented by the operation of Reclamation's Nebraska-Kansas Projects facilities was $40,254,000 as determined by the Corps of Engineers. An additional water year 2011 benefit of $10,447,200 was credited to Harlan County Lake. The accumulative total of flood control benefits for water years 1951 through 2011 by Reclamation facilities in this report total $2,066,406,100.

Operations – December 31, 2012.

Corps and Reclamation storage lakes in the District contained a total of 4,259,933 AF of storage on December 31, 2012. Of the total volume in storage, 474,269 AF (11 percent) were contained in the Reclamation lakes and 3,785,664 AF (89 percent) were contained in the Corps projects.

None of the eighteen Corps lakes and none of the eleven Reclamation lakes in the District contained storage in their flood control pools on December 31, 2012. The occupied flood control storage amounted to 0 AF. This volume compares to 6,408,803 AF of flood control storage space occupied on August 1, 2011.

MAJOR REGULATION PROBLEMS AND PROPOSED SOLUTIONS.

Drought Effects on Inflows

	Actual Inflow	Historical Average	% of Normal
Osage Basin	3,699,679 AF	8,278,785 AF	45%
Kansas Basin	1,015,951 AF	3,055,228 AF	33%
Smoky Hill Basin	40,297 AF	302,215 AF	13%
Republican Basin	78,581 AF	291,262 AF	27%
Missouri Locals	68,993 AF	160,678 AF	43%
Chariton Basin	98,234 AF	344,472 AF	29%

Operational Challenges:

Osage Basin- The spring months were the most active with Truman reaching an elevation of 714.39 ft on 30 March 2012. The lowest elevation of 704.26 occurred on 3 December 2012. In late August Hurricane Isaac came up from the mouth of the Mississippi River and into the Osage Basin. Although 3-5 inches of rain fell across the Osage basin, surprisingly little runoff was generated. Melvern, Pomona and Hillsdale were called upon by the Kansas Water Office to supply water for KCP&L power plant near LaCygne. This operation started in mid July and ended the first week in September. Stockton continued to supply water to the city of Springfield. Late in the year, a coordination meeting was held between Ameren, Southwestern Power Agency, and the Kansas City Water Management Staff to assess communication methodology between the agencies. Due to the ongoing drought, the Stockton and Truman power plants generated approximately one third of the megawatts expected during a similar timeframe. The Stockton power plant will be unavailable from February 2013 through the spring of 2014 due to a major rehabilitation project.

Kansas Basin- Drought conditions persisted throughout most of 2012 in the Kansas Basin. This necessitated increasing releases from Milford, Tuttle Creek and Perry Lakes to maintain the Water Quality targets at Topeka and Desoto beginning in June. In July, Missouri Basin Water Management Division requested releases for Navigation support for the Missouri River. Milford, Tuttle Creek and Perry Lakes were drawn down 3 ft below their multi-purpose elevations before the Navigation Supplementation releases were discontinued. In August, Milford Lake's release was temporary decreased to 0 cfs at the request of the Geary County Sheriff's Office to aid in a body recovery effort downstream. An increase in the Tuttle Creek release was coordinated with this operation to maintain the Water Quality Targets. At the end of 2012 Milford Lake elevation was 6.6 ft. below multi-purpose, Tuttle Creek Lake was 12.4 ft below multi-purpose, Perry Lake was 5.31 ft. below multi-purpose. Clinton Lake was 3.54 ft. below multi-purpose at the end of 2012 with only low flow releases of 7-21 cfs being made throughout the year.

Smoky Hill Basin- 2012 was the first year for implementation of an agreement with Kansas Water Office for Kanopolis low flow releases. The agreement was reached after two years of study and a determination that Kanopolis water could be conserved during dry periods by lowering the water quality release to 20 cfs at Mentor. The previous standard was 50 cfs during the summer months. The agreement required close monitoring of the Mentor gauge and numerous gate changes to maintain the minimum flow. Approximately 7200 ac-ft of water was conserved during the summer of 2012. This equates to 2.5 feet in the Kanopolis pool. Kanopolis Lake only received 11% of normal inflows during calendar year 2012.

Republican Basin- The Bureau of Reclamation (Reclamation) formally requested on December 18, 2012 that the Kansas City District (NWK) deviate from the Harlan County Water Control Manual. Reclamation requested that NWK permit 20,000 acre-feet of water stored in the Harlan County Lake sediment pool be used for irrigation. The water would be in addition to the irrigation water identified in the Consensus Plan for Harlan County Lake. Reclamation states that the deviation would benefit the irrigation purpose of the Kansas Bostwick Irrigation District. Reclamation further states that if the deviation is approved and additional stored water will be available from Harlan County, Reclamation would request that the Nebraska Department of

Natural Resources rescind closing notices on Federal water storage rights in the Republican River Basin. The closing notices prohibit Reclamation's storage of water within federal projects in Nebraska. Reclamation's request for a deviation in Harlan County Lake will not be advanced.

Missouri Locals- Minimum releases were maintained most of the year. Longview Lake set a new record low pool elevation of 887.96 on 31 December 2012.

Chariton Basin- Routine gate changes were performed during the year. There were no significant operational challenges.

Water Level Management Plans

Paragraph 8-5 of the Osage River Basin Master Manual, Volume 1, December 1968, reads as follows: "Fish and Wildlife. Control and manipulation of water levels, both in the multipurpose pool and in the lower 2 or 3 feet of the flood pool, can be very beneficial to fish and wildlife when properly timed and executed. The level of the reservoir, degree of fluctuation, and timing of these conditions will have an extremely important effect on fish spawning. The possibility of achieving some control of production of rough fish species is also a factor favoring close control and manipulation of water levels."

In February 2008 this paragraph was reviewed by Kansas City District counsel and the Reservoir Control Center. A consensus was reached with the following conclusions:

a. Paragraph 8-5 applies to each Corps of Engineers reservoir in the Osage basin, and
b. Paragraph 8-5 gives the Kansas City District Hydraulic Engineering Branch the authority to approve Water Level Management Plans.

District Council has determined that it is no longer necessary to seek deviations for Water Level Management Plans at Kanopolis, Long Branch, Perry, Pomona, Stockton, Tuttle Creek, Wilson, or Truman reservoirs. The Chief of the Hydraulic Engineering Branch now has the authority to approve Water Level Management Plans at these lakes. Public hearings are now planned to change the language in the Reservoir Regulation Manuals for Clinton, Hillsdale, Melvern, Milford, Pomme de Terre, Rathbun, Smithville, Keith Sebelius, Kirwin, Lovewell, Waconda, and Webster reservoirs.

Endangered Species Act.

Releases at Milford and Tuttle Creek Lakes are typically affected each summer by special operations required by the Endangered Species Act (ESA). Two listed bird species, the Piping Plover and the Least Tern, were first reported nesting on sandbars in the Kansas River during the mid-1990's. These birds have also affected operations along the Missouri River upstream of Omaha since they were first listed under ESA in 1985. The Terns and Plovers nesting season

typically lasts from May through August. During that period, the Corps monitors the bird nests and when possible restricts releases from upstream lakes to protect them to the extent practical from local uncontrolled runoff. The lakes can only control a portion of the basin runoff from spring and summer storms, and many times the runoff from storms closer to the nests are sufficient to destroy them. Since the major nesting areas to date have been in the Manhattan to Topeka reach of the river, these operations have mainly affected Milford and Tuttle Creek Lakes. In previous years, as much as 17 percent of the flood pool at Tuttle Creek Lake has been forced into storage by ESA concerns.

In accordance with a U.S. Fish and Wildlife Service Missouri River Biological Opinion, the District has developed a plan of operation to monitor the nesting areas and coordinate lake releases. All four reaches of the Kansas River were surveyed during May, June and early July. Survey crews consisted of employees from the US Fish & Wildlife and the US Army Corps of Engineers. Although there was an abundance of suitable habitat, no least terns or piping plovers were observed during any of the nest surveys. There was no requirement for deviation from the reservoir regulation manuals to satisfy ESA considerations.

WATER CONTROL MANUALS.

Manual Status.

This section serves to provide the information requested in paragraph 13c of ER 1110-2-240, dated October 8, 1982, regarding the status of water control manuals.

Water control plans prepared for specific projects and basins within the Kansas City District have been documented in appropriate manuals as directed by paragraph 6c of the above referenced ER. Paragraph 6c also directs that water control plans be revised as necessary to conform with changing requirements resulting from developments in the basin, improvements in technology, new legislation, or other relevant factors, provided such revisions comply with existing Federal regulations and established Corps of Engineers policy.

No water control manuals were submitted to Division for approval during the reporting period. The Schedule and Status of manuals for all projects are shown on ***Table 3***.

Table 3: Project Manual Status and Revision Schedule

Reservoir/Lake	Stream/River	Owner	Report Status	Submission Schedule
Nebraska				
Master Manual	Republican	CE	Updated final submitted to NWD for review July 28, 1977	
Harlan County	Republican	CE	Major Revision approved by NWD May 10, 2001	
Harry Strunk	Medicine Creek	BR	Approved by NWD July 12, 1974	
Enders	Frenchman Creek	BR	Approved by NWD March 26, 1973	
Swanson	Republican	BR	Flood Control Plan approved by HQUSACE October 6, 1969	
Hugh Butler	Red Willow Creek	BR	Flood Control Plan approved by HQUSACE November 21,1969	
Colorado				
Bonny	S. Fork Republican	BR	Approved by HQUSACE October 6, 1969	
Kansas				
Lovewell	White Rock Creek	BR	Minor revision approved March 9, 2010	
Milford	Republican	CE	Approved December 1984. Minor revision approved Jan 1995	
Norton	Prairie Dog Creek	BR	Approved August 28, 1974	
Master Manual	Smoky Hill	CE	Approved March 28, 1975	
Kanopolis	Smoky Hill	CE	Revision submitted to NWD October 30, 1984	
Cedar Bluff	Smoky Hill	BR	Approved by NWD September 25, 1975	
Kirwin	N. Fork Solomon	BR	Approved by NWD February 6, 1974	
Webster	S. Fork Solomon	BR	Approved by NWD July 16, 1975	
Wilson	Saline	CE	Approved by NWD June 18, 1984, subject to comments	
Waconda	Solomon River	BR	Approved by NWD July 12, 1972	
Master Manual	Kansas	CE	Approved by HQUSACE March 22, 1967 subject to comments	
Tuttle Creek	Big Blue	CE	Approved April 16, 1974. Minor revision approved January 1995	
Perry	Delaware	CE	Approved July 1973. Minor revision approved January 1995	
Clinton	Wakarusa	CE	Approved February 12, 1980	
Master Manual	Osage River	CE	Approved by HQUSACE Sep 21, 1970 subject to comments	
Pomona	110 Mile Creek	CE	Approved February 1973	
Melvern	Marais Des Cygnes	CE	Approved June 27, 1985	
Hillsdale	Big Bull Creek	CE	Approved by NWD June 19, 1985	
Missouri				
Pomme De Terre	Pomme De Terre	CE	Approved by NWD, February 8, 1972.	
Harry S Truman	Osage	CE CE	Interim manual approved by NWD May 12, 1981. Minor revision approved April 1996	
Stockton	Sac	CE	Approved August 21, 1975	
Smithville	Little Platte	CE	Approved August 12, 1979	
Long Branch	E. Fk Ltl. Chariton	CE	Interim manual approved November 21, 1978	
Longview	Little Blue	CE	Approved February 15, 1994	
Blue Springs	E. Fork Little Blue	CE	Approved January 27, 1994, minor revisions submitted Dec 1994	
Iowa				
Rathbun	Chariton	CE	Approved by NWD, October 19, 1981	

Other Reports

Plates 2A-E list project data showing the date impoundment of storage began, the date the multipurpose pool (the active conservation pool in USBR projects) first filled, and the current status of Standing Instructions for Regulation of Storage in Corps of Engineers Lakes.

As indicated in Engineering Manual 1110-2-3600, it is essential that project operators (dam tenders, operations managers, power plant superintendents) at the various flood control and multiple-purpose reservoirs be supplied with regulation schedules to be followed in case of communication failure. These regulation schedules should be followed in case of communication failure with the headquarters from which instructions are normally issued during flood situations. Standing Instructions have not yet been issued for Harry S Truman Reservoir, Clinton, Hillsdale, Long Branch, Smithville, Longview, and Blue Springs Lakes.

HYDROLOGIC DATA COLLECTION.

The primary objectives of Kansas City District's hydrologic data program is to provide information on precipitation and stream flow characteristics occurring over and within a particular area for a given period of time. These data are used for many purposes, including the design, construction, and maintenance of a wide variety of structures in and along streams; the management of lake releases during floods; the production of hydropower; the design and maintenance of navigation facilities; the control of pollution; the management of flood plains; the development of recreational facilities; the design of highway bridges and culverts; the establishing and administering of water rights and compacts; and the resolving of political, social, and legal water problems. As with any program, however, the restraint on funds and manpower, and the usefulness of the data obtained will determine to what extent the program will, or should, be pursued at any particular point in time. The overall program of observing, monitoring, and collecting hydrologic and meteorological data in the District is quite extensive yet flexible to meet operational and economic needs. Brief descriptions of the various types of data collection now being utilized are presented in the following paragraphs.

Collection and Processing of Water Control Data.

Hydrologic data such as precipitation, stream flow, and lake information are collected in the Kansas City District by: individual observers, Corps project offices, the National Weather Service, the Geological Survey, the Bureau of Reclamation, and certain state agencies. Several different methods of communication are used in the Kansas City District to receive this data including: electronic transfer, e-mail, and telephone. The electronic transfer of data uses SFTP between agency computers and data transmitted through a satellite downlink and a Local Readout Ground Station (LRGS). Data received by the District is entered onto the Water Management Section's Corps Water Management System (CWMS) by both automated and manual methods, depending on the data source. CWMS and Software developed by Water Management Section staff provides a means to view, screen, and process the data for graphical and reporting purposes. The data is then uploaded to the MSC CWMS in Omaha. Daily data and project reports are also available to the public at the Section's web site, http://www.nwk.usace.army.mil/locations/watermanagement.aspx.

The Water Management Section is using a Unix system. Hardware is available in Omaha for a backup server if needed.

Automatic Remote Sensors.

Data Collection Platforms (DCP's) are the primary means by which Kansas City District obtains remote sensing data on stream stages and lake elevations. The DCP is a sophisticated device that collects the information from a stage/elevation sensor and transmits the data to a GOES satellite for subsequent retrieval by the National Environmental Satellite, Data, and Information Service (NESDIS) at Wallops Island, Virginia. NESDIS then rebroadcasts all data over a single high-speed channel on a Domestic Communications Satellite (DOMSAT). The Water Management Section receives DCP data from NESDIS or directly from the DCP's with a DOMSAT receiver station. Maintenance of the DCP's is performed by the USGS under contract with the Corps of Engineers. For Fiscal Year 2013, the District will support 91 permanent DCP's, unchanged from the previous year. A breakdown of the total number of DCP's, by states, shows 41 units in Missouri, 35 in Kansas, 9 in Nebraska, and 6 in Iowa.

Cooperative Streamgaging Programs.

Constraints on funds and manpower do not allow the Corps to administer an independent data collection program that satisfies all of its needs. Therefore, assistance is sought from other cooperating agencies. A nationwide program of data collection at selected stream gauging stations has been administered for a number of years by the U.S. Geological Survey (USGS). A similar network of reporting stations has been operated by the National Weather Service (NWS) for their river forecasting services. Arrangements have also been made with the USGS through which they supplement their network of reporting stations, or increase the frequency of reports, to better satisfy Corps needs. The program, designated the "Cooperative Hydrologic Reporting Network," is administered by the USGS and supported by funds transferred from the Corps and by National Streamflow Information Program (NSIP) funds. Arrangements for the services provided are made with USGS data chiefs in each state and submitted annually to the Chief of Engineers, through the Division Commander and the Hydraulic Engineering Center, for review and approval. A summary of funds expended for data collection purposes during the report period is included in the Personnel and Funding section at the end of this report.

Water Quality Investigations and Monitoring Activities.

Lake Projects - All 18 District reservoirs were sampled from April through September for nutrients, pesticides, metals, sediment, chlorophyll a, and in-situ water column profiles. Sampling efficiency was not affected by the drought experienced in 2012. Environmental staff Limnologist and Lake Project personnel completed all monthly lake and inflow sampling. Moderate to exceptional drought in the Midwest and most of the Missouri River watershed caused low inflows, outflows, and decreasing lake levels. Environmental variables and reduced flow through the lakes resulted in stagnant conditions and reduced water quality compared to average years. Swim beaches and blue green algae blooms are sampled by District staff, state health departments, and/or contract labs for E. coli bacteria, and harmful algae

populations/toxins for public safety alerts and beach closures. There were health advisories issued in Kansas due to algal toxins, but no warnings issued in 2012 indicating that algal toxin levels and cell counts did not exceed the dangerous levels prohibiting whole body contact recreation. A moderate cyanobacteria bloom at Milford Lake caused one to two week public health advisories for parts or all of Milford in June, July, August and September 2012. One public beach at Milford Lake was closed for a week during June, July and August in response to the cyanobacteria public health advisories. Zebra mussel veliger samples were collected from six District lakes not classified as infested. District lakes with documented populations of zebra mussels include Wilson, Kanopolis, Perry, Milford, Rathbun, Smithville, and Melvern Lakes. The Melvern Lake expanding zebra mussel population will eventually affect the Marais de Cygnes River and downstream Truman Reservoir. The WQ Program continues to participate with watershed groups for Kanopolis (Smoky Hill), Clinton (Upper Wakarusa), Tuttle Creek, Perry (Delaware River), Pomona, Melvern, Milford, Hillsdale, and Rathbun (Chariton).

Missouri River - NWK staff sampled seven Missouri River mainstem sites and eleven Missouri River tributary sites in support of the Missouri River Recovery Program (MRRP) in 2012. In conjunction with samples collected by NWO staff, this data will be used to facilitate the application of a CE-QUAL-W2 hydrodynamic and water quality model on the lower Missouri River. This sampling was completed on a monthly basis. Flows and water levels did not prevent access to sites or hinder sampling in any way this year. In contrast to the extended flooding in 2011, water levels on the lower Missouri River in 2012 averaged at or below the construction reference plane (CRP) for the majority of the sampling season (March through October) in the lower end of the basin. A historical nutrient study was undertaken in response to the National Academy of Sciences (NAS) study recommendations to better characterize historical nutrients in the floodplain of the Missouri River to evaluate whether differences exist between historical sediments and shallow water habitat (SWH) sites. Soil and adjacent river water were sampled at eleven sites in the historical floodplain of the Missouri River, analyzed for nutrients, and mixed to produce elutriate solutions to assess the potential of nutrient leaching from soil to water during construction of SWH sites. We are currently working with USGS on the analysis of these NAS sites. Five site characterizations were performed at potential locations for SWH construction projects. Wolf Creek Bend, Benedictine Bottoms, Jameson Island (extension), Bakers Bend, and Cora Island were assessed for nutrients, metals, and organic contaminants along each proposed chute alignment. River water was also collected at each site for the analysis of elutriate solutions. Results indicated that no federal or state water quality standards were exceeded at any site. When compared with the seven ambient Missouri River mainstem monitoring sites, analyte concentrations in elutriates were found to be less than (in the case of phosphorus) or similar to (in the case of nitrogen) ambient concentrations in the River. Water samples were also collected upstream and downstream of three chutes already present to evaluate any differences in water quality that might arise from water flowing through the chute as opposed to the main channel. All data analyzed to date indicate that no statistical difference exists between the water entering to the water exiting the chutes. Information gained from the NAS historical nutrient study, the SWH site characterizations, and the post-construction chute monitoring will ultimately help the Corps to assess potential water quality impacts from SWH creation efforts and to affirm the Corps position that construction of SWH has no negative impacts on Missouri River water quality. Water quality, zooplankton, and phytoplankton samples were also collected at six

current SWH sites by the Habitat Assessment and Monitoring Program (HAMP). These efforts will help the Corps design, build, and adaptively manage USACE projects as we better understand the physical, chemical, and biological responses to SWH on the Missouri River. In 2012, Corps staff continued to monitor for estrogen compounds in the Missouri River which will provide insight as to the presence of these compounds in the system as the concern of biological significant emerging contaminants continues to grow.

Sediment Observations.

Revised Area-Capacity tables were implemented on March 1, 2012 as a result of bathymetric surveys conducted from 2007-09 for the following Kansas Lakes: Kanopolis, Wilson, Milford, Tuttle Creek, Perry, Clinton, Hillsdale, Pomona, and Melvern.

In 2009-10 bathymetric data was obtained by contract using ARRA funds for the remaining NWK lakes with the exception of Long Branch. However, no LIDAR (Light Detection and Ranging) data was obtained and Area-Capacity tables could not developed. The Bathymetric surveys were used to monitor sediment accumulation.

The US Bureau of Reclamation obtained survey data for Bonny Lake in 2010 and developed new Area-Capacity tables, which were implemented on January 1, 2011.

Four outlet channels were inspected during the report period:

Pomona Lake - Periodic General Inspection # 10 was conducted on 19 and 20 October 2011. The stone protection on left side of the outlet channel is severely broken down. Severe stone breakdown and subsequent erosion has resulted in the formation of relatively smooth gentle slope with a step up to the parking lot where large rock is still intact near elevation 932'. This process is on-going and is likely to threaten the concrete ramp and service/maintenance parking lot nearby. A survey has been recommended to determine how much material has been lost and if an overlay is necessary for a wider area than just protection of the ramp and service parking lot. Five cross sections were surveyed in the outlet channel and stilling basin. The side slopes of the river channel appear to be less stable than during previous survey years, likely due to high discharges that were released during the summer 2010 high water event. Over the past five years the channel has seen minimal variation, but recent lateral shifting and bank steepening were observed at several ranges. This observation is not considered an immediate dam safety concern. The channel is generally stable, although some lateral shifting is present. Otherwise, there appear to be no significant shifts in the channel geometry. Several trees and root balls in the channel were observed during the degradation survey. These obstructions may cause minor impacts to channel capacity.

Pomona Lake outlet channel.

Pomme de Terre Lake - Periodic General Inspection #10 was conducted on 4-5 April 2012. The rock cut side walls of the outlet channel excavation were examined and found to be satisfactory. Degradation Ranges 1 through 6 and 8 were surveyed. The surveyed channel at the degradation ranges is extremely stable. This is the case for the entire reach of the river channel because of exposed bedrock on the channel bed. During the stilling basin repair completed in 2011, six 3-ft by 3-ft by 1.5ft concrete blocks were placed immediately downstream of the stilling basin on the right side of the channel. These blocks were used as anchors for the wall forms and now provide fish habitat. They do not obstruct flow in the channel and do not impact to the channel's hydraulic capacity. A boat ramp exists in the outlet channel about 3,000 feet downstream of the stilling basin, but does not adversely affect the channel's hydraulic capacity.

Perry Lake - Periodic General Inspection #13 was conducted 9-10 May 2012. Both sides of the stilling basin and banks of the outlet channel were inspected. The Delaware River was also

inspected by boat from the outlet channel to the confluence with the Kansas River during the degradation study. The outlet channel extends downstream just beyond the confluence of the old river channel.

The degradation ranges were surveyed with both GPS RTK and hydrographic survey equipment in May 2012. Due to the extreme disrepair of the degradation range monuments, only six of the nine degradation ranges were found. Range 9 and 8 directly downstream of the dam are the only ranges with both monuments intact. Over the last 32 years the degradation ranges have experienced minor cutting at the upstream end and minor filling at the downstream end. Near the dam the channel is widening but no significant change in bed elevation was measured. Results downstream of Range 8 suggest the channel has had unstable banks since the dam's construction.

The original design width of the channel bed was 100 feet. The width at Range 9 is now approximately 140 feet. At Range 9 the channel has lowered about 3 feet. No significant vertical movement has occurred since the previous periodic inspection.

The Delaware River channel was inspected by boat to the confluence with the Kansas River. Several large trees have fallen into the river. This may be a potential issue to bridges and docks along the river but it is not expected to cause hydraulic impacts on the river.

The outlet channel is hydrologically adequate and is operating as designed.

Blue Springs Lake - Periodic General Inspection #9 was conducted on 23–24 October 2012. The outlet channel was visually inspected from the stilling basin to the original channel of the East Fork of the Little Blue River. The 18-inch riprap at the outlet channel on the left and right banks was in good condition. No significant woody vegetation or other obstructions are along the side slopes and the rock is in relatively good shape. Some scouring was observed at the transition from grouted to non-grouted riprap on both the left and right banks downstream of the plunge pool area. The channel was incised approximately 1.5 ft in 1998 with a further drop of approximately 1.5 feet between 1998 and 2003. Since 2003, no significant vertical degradation has occurred in the channel bed. The channel banks have steepened and become less stable since 2008. The degradation poses no dam safety concern at this time. No channel obstruction or restriction was observed. No adverse hydraulic control exists at this time. The river channel was inspected during the periodic inspection and the degradation survey. The overbanks are forested beyond about 1200 feet downstream of the stilling basin. The banks are relatively steep and unstable. There is a potential for the unstable bank erosion to propagate upstream into the outlet channel, which would require bank intervention. The outlet and river channels should continue to function as designed.

Blue Springs Outlet Channel

Through an interagency cooperative agreement with the USGS, the District collects point, depth integrated, and bed sediment samples at two Missouri River stations. The Missouri River data at St. Joseph, Kansas City, and Boonville include point velocities. Laboratory analyses are performed at the USGS facility at Rolla, Missouri, and the results are stored in their database.

RESEARCH AND STUDIES.

.

Kanopolis Release Rates - The Kansas Water Office completed a Water Quality study on January 28, 2011 with the conclusion that a reduced release would improve the Kanopolis Lake beneficial purposes during periods of drought. The report further concluded that flood control benefits would not be adversely affected. The Corps concurs and as a result, the summer seasonal minimum target at Mentor was reduced from 50 cfs to 20 cfs. The winter target will remain at 10 cfs.

ResSim Modeling- Water Management staff are currently participating in the development of ResSim models covering the Kansas, Osage, and Chariton Rivers. The work is being funded

through the Missouri River Recovery Program and will be coordinated with HEC-RAS modeling on the Missouri River for future planning purposes. Applications could include evaluation of Recovery Program alternatives and reservoir regulation manual revisions. This is a multi-year effort involving staff in both the Water Management Section and the Hydrology and Hydraulics Section. Similar work is ongoing in the Omaha District covering the upper portion of the Missouri River Basin. During FY12 and the early months of FY13, the ResSim models are being developed and calibrated. Observed flow records at gage points within the models are being extended back to 1897 using Bulletin 17B and Flow Frequency Study methodologies.

Rathbun Lake Manual Revision- The Chariton River ResSim model development is partially funded by Operations Division. The model will be used for evaluation of alternative operation scenarios proposed for a Rathbun Lake Regulation Manual revision. Concurrently, staff have identified and initiated discussions with local stakeholders and State interests. In the years since the manual was last updated in 1980, the basin has experienced two major floods resulting in surcharge operations with two additional events approaching the top of the flood pool, the State has invested heavily in lake facilities including the Honey Creek Resort, extensive land use changes have occurred downstream, and the stilling basin has been upgraded to safely pass flows up to 3000 cfs.

Bathymetric Surveys- During the 2010-12 period, a District PDT including Water Management staff used ARRA Stimulus funding to obtain bathymetric surveys at all of the District lakes except Long Branch Lake. This was a cooperative effort with the US Geological Survey and the State of Kansas. The State of Kansas provided the bathymetric surveys at six of the nine Kansas Corps lakes through the Kansas River PAS Study. LiDAR terrain data for the Kansas lakes was obtained through an ARRA-funded contract and from the cooperating agencies. This enabled the development of new Area-Capacity tables at the nine Kansas lakes, including Kanopolis, Wilson, Milford, Tuttle Creek, Perry, Clinton, Hillsdale, Pomona, and Melvern. The new tables were implemented operationally on March 1, 2012. At other NWK lakes in Missouri, Iowa, and Nebraska, the bathymetric data was used to develop current level reservoir bottom GIS surfaces and to update reservoir sedimentation estimates and distributions.

TRAINING AND METHODS.

Training of Water Management Section staff progresses as time and scheduling permit. Technical abilities are enhanced as individuals continue to pursue courses on their own initiative. During the period of this report, Section employees participated in the training courses listed in

Table 4: Staff Training

Employee	Course or Training
Engineer 1	None
Engineer 2	None
Engineer 3	Flood Frequency Analysis
Technician 1	Introductory GIS
Technician 2	None
Technician 3	Excel
Engineer 4	HEC Res-Sim
Engineer 5	None
Technician 4	InfoSec World Conference & Expo

Table 4. All staff members attended in-house training of Violence in the Workplace, Operation Security (OPSEC), Suicide Prevention for DA Civilians, Sexual Harassment/Assault Response and Prevention (SHARP), No Fear, Level 1 Anti-Terrorism Awareness, Combating Trafficking in Persons (CTIP), Individual Development Plan Status (IDP), Threat Awareness Reporting Program (TARP), and Army Accident Avoidance.

PERSONNEL AND FUNDING.

Personnel.

Authorized positions of the Water Management Section at the close of the fiscal year (September 30, 2012) consisted of one Supervisory Hydraulic Engineer, four Hydraulic Engineers, and four Hydrologic Technicians. At the end of this reporting period, the Section had no vacant positions. A listing of personnel in the Section at the end of the report period by name and title is shown in ***Table 5***.

Table 5: Water Management Section Personnel

Employee	Grade
(1)	GS-13
(2)	GS-12
(4)	GS-11
(4)	GS-7
(4)	GS-11
(4)	GS-11
(2)	GS-12
(2)	GS-12
(2)	GS-12
Job Title	
(1) Supervisory Hydraulic Engineer	
(2) Hydraulic Engineer	
(3) Hydrologist	
(4) Hydrologic Technician	

Funding.

Activities of the Water Management Section are funded from the following sources:

Planning

Part of the funds appropriated for survey reports, flood plain information studies, and project planning studies are assigned to the Water Management Section for special studies if water control is included in connection with the planning and design.

Operations and Maintenance

Operation of the existing lakes and reservoirs in the Kansas City District requires stream flow forecasting, water control planning, stream gauging, and other related activities for each authorized function at Corps of Engineers projects, and for the flood control function at Bureau of Reclamation projects. Operation and maintenance funds are used for these purposes.

Technical Services and Flood Emergency

Technical services provided to non-Federal interests, flood emergency operations, post flood reports, and the annual flood report are tasks assigned to the Water Management Section. These activities vary from year to year. Special accounts are provided for these services. Individuals in the Section may also receive special funding from other sources when they participate as a technical resource on Project Development Teams.

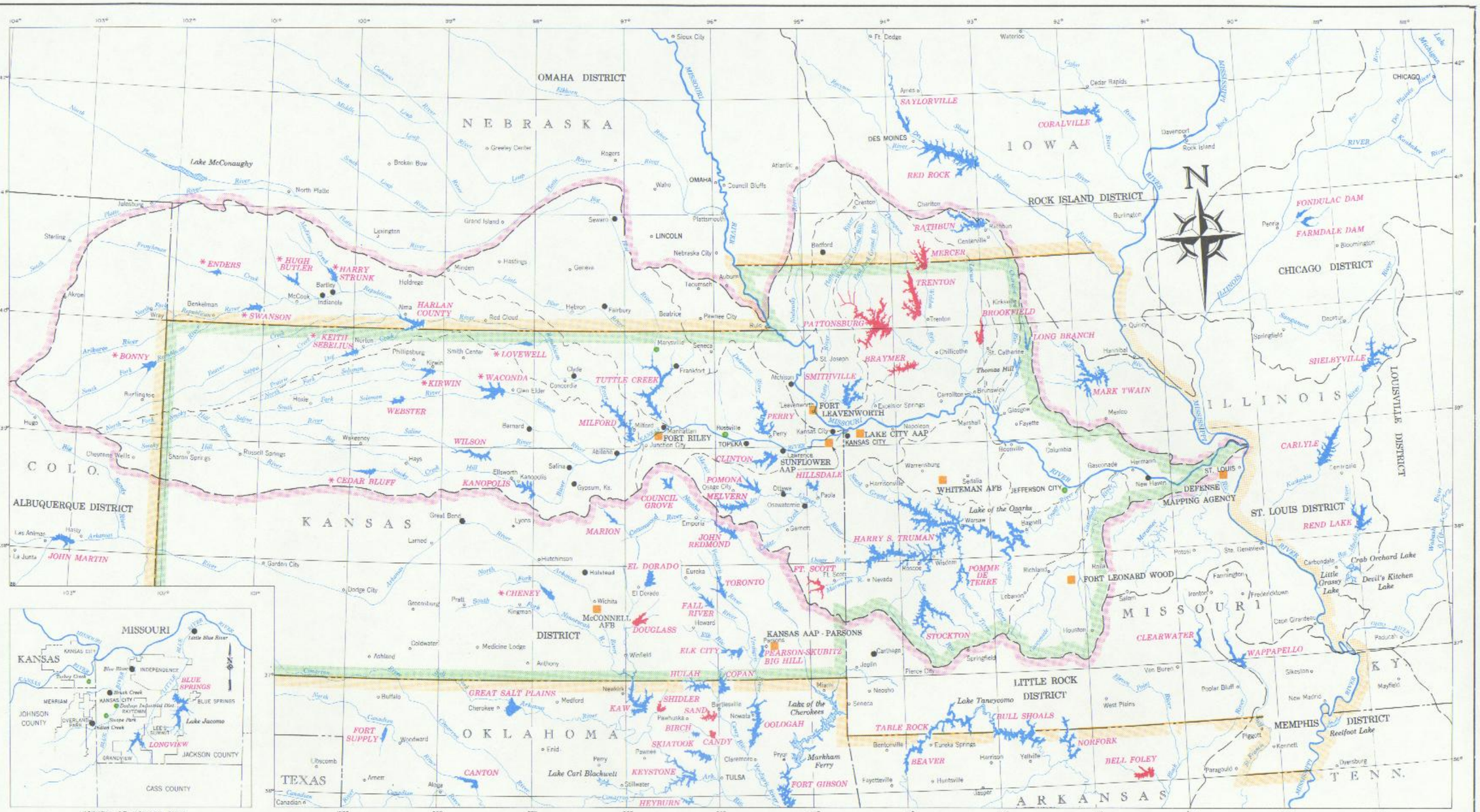
Data Collection Programs

The Cooperative Stream Gauging Program with the four U.S. Geological Survey districts (Kansas, Nebraska, Iowa, and Missouri) includes 91 stations. Kansas City District funding for this program during FY 2013 is $1,095,775, a 0.03% drop from FY 2012.

Fiscal year expenses for data collected in FY 2011 and FY 2012, and the programmed expenses for FY 2013 are shown in ***Table 6*** below.

Table 6: Data Collection Expenditures

Program	FY 2011	FY 2012	FY 2013
U.S.G.S	$1,229,235	$1,096,138	$1,095,775
Independent Stations	$0	$0	$0
TOTAL	$1,229,235	$1,096,138	$1,095,775


OMAHA DISTRICT
NEBRASKA
IOWA
ROCK ISLAND DISTRICT
CHICAGO DISTRICT
ILLINOIS
LOUISVILLE DISTRICT
ST. LOUIS DISTRICT
KANSAS
COLO.
ALBUQUERQUE DISTRICT
OKLAHOMA
TEXAS
MISSOURI
KY.
TENN.
ARKANSAS
LITTLE ROCK DISTRICT
MEMPHIS DISTRICT
KANSAS AAP - PARSONS
FORT LEAVENWORTH
LAKE CITY AAP
KANSAS CITY
FORT RILEY
SUNFLOWER AAP
WHITEMAN AFB
DEFENSE MAPPING AGENCY
FORT LEONARD WOOD
McCONNELL AFB
Lake McConaughy
Lake of the Ozarks
Lake of the Cherokees
Lake Taneycomo
Lake Carl Blackwell
Markham Ferry
Crab Orchard Lake
Little Grassy Lake
Devil's Kitchen Lake
Reelfoot Lake
ENDERS
HUGH BUTLER
HARRY STRUNK
SWANSON
HARLAN COUNTY
KEITH SEBELIUS
BONNY
LOVEWELL
WACONDA
KIRWIN
WEBSTER
TUTTLE CREEK
MILFORD
WILSON
CLINTON
CEDAR BLUFF
KANOPOLIS
MARION
COUNCIL GROVE
JOHN REDMOND
POMONA
MELVERN
HARRY S. TRUMAN
POMME DE TERRE
STOCKTON
TABLE ROCK
BULL SHOALS
NORFORK
BEAVER
BELL FOLEY
CLEARWATER
WAPPAPELLO
RED ROCK
SAYLORVILLE
CORALVILLE
RATHBUN
MERCER
TRENTON
PATTONSBURG
BRAYMER
SMITHVILLE
PERRY
LONG BRANCH
BROOKFIELD
MARK TWAIN
SHELBYVILLE
CARLYLE
REND LAKE
FONDULAC DAM
FARMDALE DAM
HILLSDALE
JOHN MARTIN
CHENEY
EL DORADO
TORONTO
FALL RIVER
DOUGLASS
ELK CITY
PEARSON-SKUBITZ BIG HILL
HULAH
COPAN
GREAT SALT PLAINS
KAW
SHIDLER
SAND
BIRCH
SKIATOOK
CANDY
KEYSTONE
OOLOGAH
FORT SUPPLY
CANTON
HEYBURN
FORT GIBSON
VICINITY OF KANSAS CITY
MERRIAM
JOHNSON COUNTY
KANSAS CITY
RAYTOWN
INDEPENDENCE
BLUE SPRINGS
LEE'S SUMMIT
LONGVIEW
GRANDVIEW
JACKSON COUNTY
CASS COUNTY
Lake Jacomo
Swope Park
Indian Creek
Brush Creek
Blue River
Little Blue River
Todd Creek
Dodson Industrial Dist.
OVERLAND PARK
SCALE IN MILES
LEGEND
LAKES
COMPLETED
UNDER CONSTRUCTION
PLANNING
AUTHORIZED
RECOMMENDED
BUREAU OF RECLAMATION PROJECTS
OTHERS OF NOTE
LOCAL PROTECTION
COMPLETED OR UNDER CONSTRUCTION
AUTHORIZED
PLANNING
MILITARY BASE
BOUNDARIES
KANSAS CITY DISTRICT (CIVIL)
KANSAS CITY DISTRICT (MILITARY)
KANSAS CITY DISTRICT (REGULATORY)
OTHER DISTRICTS
DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT
CORPS OF ENGINEERS
FEBRUARY 1994
FILE NO. K-1-734
PLATE 1

SUBJECT	MELVERN LAKE	POMONA LAKE	HILLSDALE LAKE	STOCKTON LAKE	POMME DE TERRE LAKE	HARRY S. TRUMAN RESERVOIR	REMARKS
GENERAL							(1) With pool at multipurpose level.
Location of Dam	Near Melvern, KS	Near Pomona, KS	Near Paola, KS	Near Stockton, MO	Near Hermitage MO	Near Warsaw, MO	(2) Damming height is from the original riverbed to the top of the flood control pool.
Stream / River	Marais des Cygnes River	110 Mile Creek	Big Bull Creek	Sac River	Pomme de Terre River	Osage River	(3) Based on latest available storage data. The revision dates of the current area - capacity tables are indicated below with the effective dates in parentheses:
Miles above Mouth	175.4	8.3	18.2	51.4	45.6	175.1	Melvern, February 1986 (effective March 1, 1986)
Contributing Drainage Area, square miles	349	322	144	1,160	611	8,914 (4)	Pomona, March 1990 (effective April 1, 1990)
Approximate Length of Full Reservoir, miles	22	12	15	24	28	122	Hillsdale, 1969 (initial)
Shoreline, miles (1)	101	52	51	298	113	958	Stockton, February 1988 (effective May 1, 1988)
Maximum Discharge of Record nr Dam Site	68,500 cfs (July 11, 1951)	38,600 cfs (July 11, 1951)	45,200 cfs (July 11, 1951)	120,000 cfs (May 19, 1943)	70,000 cfs (Aug 8, 1927)	259,000 cfs (May 17, 1943)	Pomme de Terre, February 1985 (effective Mar 85)
Date of Closure	October 2, 1970	July 19, 1962	June 15, 1980	September 23, 1968	June 28, 1960	July 21, 1977	Harry S. Truman, April 1993 (effective Mar 94)
Date Storage Began	August 1, 1972	October 18, 1963	September 19, 1981	December 12, 1969	October 29, 1961	February 7, 1979	(4) The total drainage area above Truman Dam is 11,500 square miles. The indicated total is the local drainage area below the upstream dams.
Date Multipurpose Level Reached	April 4, 1975	June 5, 1965	February 23, 1985	December 18, 1971	June 15, 1963	November 29, 1979	(5) In 1994, 1000 AF of flood control storage at Truman Reservoir was reallocated to water supply.
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	The top of the multipurpose pool was adjusted from 706.0 to 706.018
DAM AND EMBANKMENT				911.0 for concrete section			
Top of Dam Elevation, feet msl	1,078.0	1,031.0	952.2	912.0 for embankment	906.0	756.0	
Length of Dam, feet (net)	9,650	7,750	8,700 plus 3,300 dike	5,100 plus 5,600 dike	4,630 plus 2,790 dike	5,000 plus 7,500 dike	
Damming Height, feet (2)	105	83	79	132	124	105	
Type of Fill	Earth	Earth	Earth	Rock Shell	Earth	Earth	
Fill Quantity, cubic yards	9,100,000	5,200,000	6,964,000	7,100,000	5,800,000	8,500,000	
SPILLWAY							
Location	Left Abutment	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Center of Dam	
Crest Elevation, feet msl	1,057.0	1,006.0	935.0	861.5	874.0	692.3	
Width, Feet	200	200	50	160	170	160	
Number, Size, and Type of Gates	None	None	None	4 - 40'x30.5' Tainter	None	4 - 40'x47.3' Tainter	
Discharge Capacity, Top of Surcharge Pool	36,000 cfs	50,300 cfs	4,750 cfs	182,500 cfs	73,000 cfs	284,000 cfs	
RESERVOIR (3)							**TOTALS**
Surcharge Pool Elevation and Area	1,073.0 ft msl 22,673 ac	1,025.4 ft msl 14,584 ac	948.0 ft msl 10,983 ac	906.2 ft msl 48,053 ac	900.2 ft msl 25,456 ac	751.1 ft msl 295,870 ac	417,619 ac
Flood Control Pool Elevation and Area	1,057.0 ft msl 13,935 ac	1,003.0 ft msl 8,522 ac	931.0 ft msl 7,413 ac	892.0 ft msl 38,281 ac	874.0 ft msl 15,999 ac	739.6 ft msl 209,048 ac	293,198 ac
Multipurpose Pool Elevation and Area	1,036.0 ft msl 6,912 ac	974.0 ft msl 3,865 ac	917.0 ft msl 4,575 ac	867.0 ft msl 24,632 ac	839.0 ft msl 7,790 ac	706.02 ft msl (5) 55,406 ac	103,180 ac
Surcharge Storage, AF	1,073.0 - 1,057.0 289,410	1,025.4 - 1,003.0 255,327	948.0 - 931.0 155,799	906.2 - 892.0 608,708	900.2 - 874.0 535,724	751.1 - 739.6 2,910,768	4,755,736 AF
Flood Control Storage, AF	1,057.0 - 1,036.0 208,207	1,003.0 - 974.0 176,123	931.0 - 917.0 83,570	892.0 - 867.0 776,066	874.0 - 839.0 406,821	739.6 - 706.02 4,005,392	5,656,179 AF
Multipurpose Storage, AF	1,036.0 - 965.0 152,051	974.0 - 930.0 64,208	917.0 - 852.5 76,270	867.0 - 765.0 874,887	839.0 - 750.0 237,356	706.02 - 631.0 1,181,640	2,586,412 AF
Gross Storage, AF	1,057.0 - 965.0 360,258	1,003.0 - 930.0 240,331	931.0 - 852.5 159,840	892.0 - 765.0 1,650,953	874.0 - 750.0 644,177	739.6 - 631.0 5,187,032	8,242,591 AF
Design Sediment Reserve Storage	26,000 AF for 100 years	28,000 AF for 100 years	11,000 AF for 100 years	25,000 AF for 100 years	13,000 AF for 50 years	244,000 AF for 100 years	
Measured Sediment Inflow	4,064 AF (1972 to 1985)	7,045 AF (1963 to 1989)	1,928 AF (1981 to 1993)	8,953 AF (1969 to 1987)	4,358 AF (1961 to 1974)	22,321 AF (1979 to 1992)	
OUTLET WORKS							
Location	Right Abutment	Right Abutment	Left Abutment		Right Abutment		ac = acres
River Outlet Type	Gated Horseshoe Conduit	Gated Horseshoe Conduit	Gated Oblong Conduit	None	Gated Tunnel	None	AF = acre-feet
Number and Size of Conduit	1 - 11.5'	1 - 13.5'	1 - 15.92'x11.67'		1 - 14'		ft = feet
Length of Conduit, feet	754	720.5	685		560		msl = elevation above mean sea level
Entrance Invert Elevation	962.0 ft msl	925.0 ft msl	868.0 ft msl		750.0 ft msl		cfs = cubic feet per second
Discharge Capacity, Top of Surcharge Pool	6,700 cfs	9,200 cfs	8,200 cfs		12,750 cfs		kw = kilowatts
Discharge Cap, Top of Flood Control Pool	6,235 cfs	8,170 cfs	7,400 cfs		11,500 cfs		hp = horsepower
Discharge Cap, Top of Multipurpose Pool	5,520 cfs	6,400 cfs	6,150 cfs		9,650 cfs		
Service Gates, Number and Size	2 - 6'x12'	2 - 6.5'x14'	2 - 5.33'x15.92'		2 - 6.5'x14'		
Emergency Gates, Number and Size	2 - 6'x12'	2 - 6.5'x14'	1 - 5.33'x15.92'		1 - 6.5'x14'		
Low Flow Gates, Number and Size	2 - 2'x2'	2 - 2'x2'	2 - 2'x2'	2 - 24" dia	1 - 24" Butterfly		
Provision for Power	None	None	None	3 - 20'x40'		12 - 17'x26.5'	
POWER FACILITIES							
Generator Turbine Units, Number				1		6	
Generator Name Plate Capacity, kw				45,200		160,000	
Turbine Rating, hp				75,600 (56 ft head)		254,400	
Turbine Type				Kaplan (Vertical Shaft)		Kaplan (Inclined Shaft)	
Maximum (Full Pool) Head and Discharge				112 ft (6,300 cfs)		79.2 ft (31,800 cfs)	
Avg (Power & MP Pool) Head, Discharge				85 ft (7,900 cfs)		42.5 ft (65,000 cfs)	
Minimum Head and Discharge				62 ft (11,000 cfs)		41 ft (68,000 cfs)	
Reversible Pump Turbines				None		6	
Total Dynamic Head, feet						50	
Discharge with 5 Units at Max Head, cfs						27,500	
Maximum Power Required, hp						197,000	
Maximum Drawdown, feet msl				845		704	

SUMMARY OF ENGINEERING DATA
OSAGE RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2A

SUBJECT	SMITHVILLE LAKE	LONGVIEW LAKE	BLUE SPRINGS LAKE	RATHBUN LAKE	LONG BRANCH LAKE	REMARKS
GENERAL						(1) With pool at multipurpose level.
Location of Dam	Near Smithville, MO	Kansas City, MO	Kansas City, MO	Near Rathbun, IA	Near Macon, MO	(2) Damming height is from original riverbed to top of flood pool.
Stream / River	Little Platte River	Little Blue River	East Fork Little Blue River	Chariton River	East Fork Little Chariton River	(3) Based on latest available storage data. The revision dates of the current area capacity tables are indicated below with the effective dates in parentheses:
Miles above Mouth	13.6	42.9	28.8	142.3	78	Smithville Lake, February 1990 (effective March 1, 1990)
Contributing Drainage Area, square miles	213	50.3	32.8	549	109	Longview Lake, May 1970 (initial)
Approximate Length of Full Reservoir, miles	18	3.5	2.5	14	9	Blue Springs Lake, September 1974 (initial)
Shoreline, miles (1)	175	24	12	155	24.2	Rathbun Lake, January 2000 (effective December 1, 2000)
Maximum Discharge of Record near Dam Site	76,600 cfs (July 20, 1965)	18,700 cfs (August 13, 1982)	11,000 cfs (August 13, 1982)	21,800 cfs (March 31, 1960)	30,000 cfs (April 21, 1973)	Long Branch Lake, January 1989 (effective October 1, 1989)
Date of Closure	July 13, 1976	June 16, 1983	August 12, 1986	September 29, 1967	September 3, 1976	(4) Spillway flood routing at Long Branch Lake revised for Emergency Action Plan, dated 1981.
Date Storage Began	October 19, 1979	September 16, 1985	September 27, 1988	November 21, 1969	August 2, 1978	(5) Flows above 1,800 cfs result in overtopping of the outlet stilling basin walls
Date Multipurpose Level Reached	June 11, 1982	September 23, 1986	March 18, 1990	October 10, 1970	May 19, 1981	
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	
DAM AND EMBANKMENT						
Top of Dam Elevation, feet msl	895.0	926.6	840.0	946.0	826.0	
Length of Dam, feet (net)	4,000	1,900	2,500	10,600	3,550	
Damming Height, feet (2)	80.2	110	70	82	71	
Type of Fill	Rolled Earth	Earth	Earth and Rock	Rolled Earth	Rolled Earth	
Fill Quantity, cubic yards	3,200,000	2,500,000	1,200,000	4,700,000	1,855,000	
SPILLWAY						
Location	Right Abutment	Left Abutment	Left Abutment	Right Abutment	Right Abutment	
Crest Elevation, feet msl	880.2	911.3	823.6	926.0	809.0	
Width, feet	50	200	300	500	50	
Number, Size, and Type of Gates	None	None	None	None	None	
Discharge Capacity, Top of Surcharge Pool	4,800 cfs	22,970 cfs	37,800 cfs	45,600 cfs	9,860 cfs (4)	
RESERVOIR (3)						**TOTALS**
Surcharge Pool Elevation and Area	891.1 ft msl 14,611 ac	922.9 ft msl 3,207 ac	837.7 ft msl 1,200 ac	940.0 ft msl 31,135 ac	821.2 ft msl 6,608 ac (4)	56,761 ac
Flood Control Pool Elevation and Area	876.2 ft msl 9,990 ac	909.0 ft msl 1,964 ac	820.3 ft msl 982 ac	926.0 ft msl 22,452 ac	801.0 ft msl 3,663 ac	39,051 ac
Multipurpose Pool Elevation and Area	864.2 ft msl 7,115 ac	891.0 ft msl 927 ac	802.0 ft msl 722 ac	904.0 ft msl 10,329 ac	791.0 ft msl 2,429 ac	21,522 ac
Recreation Pool Elevation and Area		870.0 ft msl 432 ac				432 ac
Surcharge Storage	891.1 - 876.2 182,198 AF	922.9 - 909.0 35,370 AF	837.7 - 820.3 19,039 AF	940.0 - 926.0 368,859 AF	821.2 - 801.0 101,880 AF (4)	707,346 AF
Flood Control Storage	876.2 - 864.2 101,777 AF	909.0 - 891.0 24,810 AF	820.3 - 802.0 15,715 AF	926.0 - 904.0 349,173 AF	801.0 - 791.0 30,327 AF	521,802 AF
Multipurpose Storage	864.2 - 810.0 141,666 AF	891.0 - 870.0 13,579 AF	802.0 - 760.0 10,842 AF	904.0 - 857.0 221,360 AF	791.0 - 750.0 34,189 AF	421,636 AF
Recreation Storage		870.0 - 810.0 8,555 AF				8,555 AF
Gross Storage	876.2 - 810.0 243,443 AF	909.0 - 810.0 46,944 AF	820.3 - 760.0 26,557 AF	926.0 - 857.0 570,533 AF	801.0 - 750.0 64,516 AF	951,993 AF
Design Sediment Reserve Storage	52,300 AF for 100 years	2,000 AF for 100 years	300 AF for 100 years	24,000 AF for 100 years	4,000 AF for 100 years	
Measured Sediment Inflow	4,987 AF (1979 to 1993)	20 AF/year (estimated)	3 AF/year (estimated)	240 AF/year (estimated)	483 AF (1978 to 1988)	
OUTLET WORKS						
Location	Right Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	
River Outlet Type	Rectangular Conduit	Concrete Arch	Arch Conduit	Horseshoe Conduit	Concrete Arch	
Number and Size of Conduit	1 - 8’x9’	1 - 5.5’x5’	1 - 3.5’x4.75’	1 - 11’	1 - 6’x5.5’	
Length of Conduit, feet	696	916	485	539	450	
Entrance Invert Elevation	805.0 ft msl	816.0 ft msl	768.5 ft msl	855.0 ft msl	760.0 ft msl	
Drop Inlet Crest Elevation		891	802.0 ft msl			
Low Flow Gate Intake Elevation		875 - 861	791.5			
Discharge Cap, Top Flood Control Pool	3,150 cfs	1,200 cfs	570 cfs	5,160 cfs (5)	910 cfs	
Discharge Cap, Top of Multipurpose Pool	2,940 cfs	0 (except low flow outlets)	0 (except low flow outlets)	4,220 cfs (5)	495 cfs	
Service Gates, Number and Size	2 - 4.25’x9.25’ Slide			2 - 6’x12’ Slide	2 - 24” Slide	
Emergency Gates, Number and Size	2 - 4.25’x9.25’ Slide	1 - 6’x7’	1-4.5’x5’	2 - 6’x12’ Slide	1 - 6’x6’	
Low Flow Gates, Number, Size, Type		2 - 24” Knife Valves	1-2’ Knife Valve			
Low Flow Gates, Number and Size	1 - 2’x2’	2 - 24” Knife Valves	1-2’ Knife Valve	2 - 2’ x2’ Slide	1 - 18” Slide	
Provision for Power	None	None	None	None	None	
Provision for Water Supply	1 - 5.75’ Pipe A portion of MP storage pumped from pool	None	None	No pipe outlets, water supply released to river	No pipe outlets, water supply pumped from pool.	

ac = acres
AF = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second

SUMMARY OF ENGINEERING DATA
LOWER MISSOURI RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City Distict
December 2004

Plate 2B

SUBJECT	MILFORD LAKE	TUTTLE CREEK LAKE	PERRY LAKE	CLINTON LAKE	REMARKS
GENERAL					(1) With pool at multipurpose level.
Location of Dam	Near Junction City, KS	Near Manhatten, KS	Near Perry, KS	Near Lawrence, KS	(2) Damming height is from the original riverbed to the top of the flood control pool.
Stream / River	Republican River	Big Blue River	Delaware River	Wakanusa River	(3) Based on latest available storage data. The revision dates of the current
Miles above Mouth	7.7	10	5.3	22.2	area - capacity tables are indicated below with the effective dates in parentheses:
Contributing Drainage Area, square miles	17,388 (4)	9,628	1,117	367	Milford Lake, March 1982 (effective March 10, 1982)
Approximate Length of Full Reservoir, miles	30	50	20	17	Tuttle Creek Lake, October 2000 (effective February 1, 2001)
Shoreline, miles (1)	163	112	160	82	Perry Lake, May 1990 (effective June 1, 1990)
Maximum Discharge of Record near Dam Site	171,000 cfs (June 3, 1935)	98,000 cfs (June 1951)	94,600 cfs (June 1951)	24,200 cfs (July 1951)	Clinton Lake, December 1991 (effective March 1, 1994)
Date of Closure	August 24, 1964	July 20, 1959	August 2, 1966	August 23, 1975	(4) Total drainage area above Milford is 38,621 square miles. The indicated total is
Date Storage Began	January 16, 1967	March 7, 1962	January 15, 1969	November 30, 1977	the local drainage area below Harlan County Dam.
Date Multipurpose Level Reached	July 14, 1967	April 29, 1963	June 3, 1970	April 3, 1980	
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	
DAM AND EMBANKMENT					ac = acres
Top of Dam Elevation, feet msl	1,213.0	1,159.0	946.0	928.0	AF = acre-feet
Length of Dam, feet (net)	6,300	7,487	7,750	9,250	ft = feet
Damming Height, feet (2)	110.2	134	95	114	msl = elevation above mean sea level
Type of Fill	Earth	Earth, Rock	Earth	Earth	cfs = cubic feet per second
Fill Quantity, cubic yards	15,000,000	21,000,000	8,000,000	10,423,000	
SPILLWAY					
Location	Right Abutment	Left Abutment	Left Abutment	Left Abutment	
Crest Elevation, feet msl	1,176.2	1,116.0	922.0	907.4	
Width, feet	1,250	1,059	300	500	
Number, Size, and Type of Gates	None	18 - 40'x20' Tainter	None	None	
Discharge Capacity, Top of Surcharge Pool	560,000 cfs	579,000 cfs	65,000 cfs	44,200 cfs	
RESERVOIR (3)					**TOTALS**
Surcharge Pool Elevation and Area	1,208.2 ft msl 59,886 ac	1,151.4 ft msl 70,030 ac	941.2 ft msl 42,656 ac	921.4 ft msl 18,336 ac	190,908 ac
Flood Control Pool Elevation and Area	1,176.2 ft msl 32,979 ac	1,136.0 ft msl 53,050 ac	920.6 ft msl 25,363 ac	903.4 ft msl 12,890 ac	124,282 ac
Multipurpose Pool Elevation and Area	1,144.4 ft msl 15,709 ac	1,075.0 ft msl 12,617 ac	891.5 ft msl 11,146 ac	875.5 ft msl 7,120 ac	46,592 ac
Surcharge Storage	1,208.2 - 1,176.2 1,442,049 AF	1,151.4 - 1,136.0 939,272 AF	941.2 - 920.6 692,375 AF	921.4 - 903.4 285,809 AF	3,359,505 AF
Flood Control Storage	1,176.2 - 1,144.4 756,669 AF	1,136.0 - 1,075.0 1,870,735 AF	920.6 - 891.5 515,795 AF	903.4 - 875.5 268,783 AF	3,411,982 AF
Multipurpose Storage	1,144.4 - 1,080.0 388,816 AF	1,075.0 - 1,020.0 280,137 AF	891.5 - 835.0 209,513 AF	875.5 - 828.0 125,334 AF	1,003,800 AF
Gross Storage	1,176.2 - 1,080.0 1,145,485 AF	1,136.0 - 1,020.0 2,150,872 AF	920.6 - 835.0 725,308 AF	903.4 - 828.0 394,117 AF	4,415,782 AF
Design Sediment Reserve Storage	160,000 AF for 100 years	240,312 AF for 50 years	140,000 AF for 100 years	28,500 AF for 100 years	
Measured Sediment Inflow	47,935 AF (1967 to 1994)	216,145 AF (1962 to 2000)	49,057 AF (1969 to 1993)	3,421 AF (1977 to 1991)	
OUTLET WORKS					
Location	Right Abutment	Right Abutment	Near Center of Dam	Left Abutment	
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	
Number and Size of Conduit	1 - 21'	2 - 20'	1 - 23.5'	1 - 12.5'x13' Arch	
Length of Conduit, feet	615.5	860	592	710	
Entrance Invert Elevation	1,080.0 ft msl	1,003.0 ft msl	833.0 ft msl	828.0 ft msl	
Gated Sluice, Number and Size	None	None	None	None	
Discharge Cap, Top of Flood Control Pool	23,100 cfs	45,900 cfs	27,500 cfs	7,570 cfs	
Discharge Cap, Top of Multipurpose Pool	18,600 cfs	31,300 cfs	21,200 cfs	5,900 cfs	
Service Gates, Number and Size	2 - 10.5'x21'	4 - 10'x20'	2 - 11.75'x23.5'	2 - 6.33'x12.67'	
Emergency Gates, Number and Size	2 - 10.5'x21'	1 - 10'x20'	2 - 11.75'x23.5'	1 - 6.33'x12.67'	
Low Flow Gates, Number and Size	2 - 2'x2'	2 - 24" Butterfly Valve	2 - 2'x2'	1 - 24" Knife Gate Value	
Water Supply Gate, Number and Size	None	None	None	1 - 54"x54" Slide Gate	
Provision for Irrigation	None	None	None	None	
Provision for Power	None	None	None	None	
Provision for Water Supply	No pipe outlets, water supply released to river	No pipe outlets, water supply released to river	No pipe outlets, water supply released to river	36" Steel Pipe	

SUMMARY OF ENGINEERING DATA
LOWER KANSAS RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2C

SUBJECT	BONNY RESERVOIR	SWANSON LAKE	ENDERS RESERVOIR	HUGH BUTLER LAKE	HARRY STRUNK LAKE	KEITH SEBELIUS LAKE (Norton Dam)	HARLAN COUNTY LAKE	LOVEWELL RESERVOIR	REMARKS
GENERAL									(1) With pool at MP level.
Location of Dam	Near Hale, CO	Near Trenten, NE	Near Enders, NE	Near McCook, NE	Near Cambridge, NE	Near Norton, KS	Nr Republican City, NE	Near Lovewell, KS	(2) Damming height is
Stream / River	S. Fk Republican River	Republican River	Frenchman Creek	Red Willow Creek	Medicine Creek	Prairie Dog Creek	Republican River	White Rock Creek	from original riverbed to
Miles above Mouth	60.4	359	81.7	18.7	11.9	74.9	232.3	19.3	top of flood control pool.
Contributing Drainage Area, sq mi	1,435	2,506 below Bonny	786	310	642	688	7,169 below u/s dams (5)	358	(3) Based on latest storage
Approx Length of Full Resv, miles	5.5	9.0	6.0	7.5	8.5	9.5	17	11	data. Date of current area
Shoreline, miles (1)	15.0	30	26	35	29	32	54	44	capacity tables given below
Max. Disch. of Record nr Dam Site	103,000 (May 31, 1935)	200,000 (May 31, 1935)	Insufficient Data	30,000 (June 22, 1947)	120,000 (June 1947)	37,500 (May 28, 1953)	260,000 (June 1, 1935)	23,300 (July 10, 1950)	with effective date in ( ).
Date of Closure	July 6, 1950	May 4, 1953	October 23, 1950	September 5, 1961	August 8, 1949	January 28, 1964	July 22, 1951	May 29, 1957	Bonny, Mar 51 (initial)
Date Storage Began	July 6, 1950	May 4, 1953	October 23, 1950	September 5, 1961	August 8, 1949	October 5, 1964	November 14, 1952	October 2, 1957	Swanson, Feb 84 (Jan 84)
Date Multipurpose Level Reached	March 19, 1954	May 15, 1957	January 29, 1952	May 21, 1967	April 2, 1951	June 21, 1967	June 14, 1957	May 20, 1958	Enders, May 97 (Jan 1, 99)
Operating Agency	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Corps of Engineers	Bureau of Reclamation	Butler, May 97 (Jan 1, 99)
DAM AND EMBANKMENT									Strunk, Oct 82 (Feb 1, 83)
Top of Dam Elevation, feet msl	3,742.0	2,793.0	3,137.5	2,634.0	2,415.0	2,347.0	1,982.0	1,616.0	Sebelius, Sep 00 (Jan 02)
Length of Dam, feet (Less Spillway)	9,141.5	8,600	2,242	3,159	5,665	6,344	11,830	8,392	Harlan, Jan 01 (Jan 1, 01)
Damming Height, feet (2)	93.0	80.0	93.0	About 85	86	85.5	98.5	70.3	Lovewell, Jun 95 (Jan 97)
Type of Fill	Earth	Earth	Earth	Earth	Earth	Earth	Earth	Earth	(4) Bartley Div Dam, Rep
Fill Quantity, cubic yards	8,853,000	8,130,000	1,950,000	3,122,000	2,730,000	3,740,000	13,400,000	3,000,000	R. below Red Willow Ck,
SPILLWAY									conc ogee weir w/2-10x16
Location	Left Abutment	Left Abutment	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Center of Dam	Right Abutment	gates to rivr, 2-10'x3' gates
Crest Elevation, feet msl	3,710.0	2,743.0	3,097.0	2,604.9	2,386.2 (see also below)	2,296.0	1,943.5	1,575.3	to canal, max cap 130 cfs.
Width, feet	121.5	142	361	31.5 (circ morning glory)	229	106	856	53	Franklin pumps on Rep R.
Number, Size, and Type of Gates	None (see notes below)	3 - 42' x 30' Radial	6 - 50' x 30' Radial	None	None	3 - 30'x36.35' Radial	18 - 40'x30' Radial	2 - 25'x20' Radial	blw Harlan Cty, cap 40 cfs.
Disch. Cap. Top of Surcharge Pool	73,300 cfs (with sluice)	126,000 cfs	202,000 cfs (with notch)	4,910 cfs	99,000 cfs (with notch)	96,000 cfs	480,000 cfs	35,000 cfs	Courtland Div Dam, Rep R
RESERVOIR (3)									**TOTALS**
Surcharge Pool Elev (ft msl), Area	3,736.2 8,579 ac	2,785.0 10,035 ac	3,129.5 ft msl 2,557 ac	2,628.0 ft msl 4,079 ac	2,408.9 ft msl 5,784 ac	2,341.0 ft msl 6,713 ac	1,975.5 ft msl 24,339 ac	1,610.3 ft msl 7,635 ac	69,721 ac
Flood Cntrl Pool Elev (ft msl), Area	3,710.0 5,036 ac	2,773.0 7,940 ac	3,127.0 ft msl 2,405 ac	2,604.9 ft msl 2,681 ac	2,386.2 ft msl 3,483 ac	2,331.4 ft msl 5,316 ac	1,973.5 ft msl 23,431 ac	1,595.3 ft msl 5,024 ac	55,316 ac
MP, or Top Cons Pool Elev, Area	3,672.0 2,042 ac	2,752.0 4,922 ac	3,112.3 ft msl 1,707 ac	2,581.8 ft msl 1,621 ac	2,366.1 ft msl 1,840 ac	2,304.3 ft msl 2,181 ac	1,945.73 msl 13,305 ac	1,582.6 ft msl 2,987 ac	30,605 ac
Inactive Pool Elev (ft msl), Area	3,638.0 331 ac	2,720.0 1,411 ac	3,082.4 ft msl 627 ac	2,558.0 ft msl 715 ac	2,343.0 ft msl 701 ac	2,280.4 ft msl 575 ac	1,932.5 ft msl 9,282 ac	1,571.7 ft msl 1,495 ac	15,137 ac
Dead Stor Pool Elev (ft msl), Area	3,635.5 242 ac	2,710.0 488 ac	3,080.0 ft msl 567 ac	2,552.0 ft msl 536 ac	2,335.0 ft msl 481 ac	2,275.0 ft msl 317 ac	1,885.0 ft msl 0 ac	1,562.07 ft msl 494 ac	3,125 ac
Surcharge Storage, AF	3,736.2 - 3,710 178,230	2,785 - 2,773 107,610	3,129.5 - 3,127 6,203	2,628.0 - 2,604.9 76,829	2,408.9 - 2,386.2 105660	2,341.0 - 2,331.4 58,287	1,975.5 - 1,973.5 47,767	1,610.3 - 1,595.3 94,145	674,731 AF
Flood Control Storage, AF	3,710.0 - 3,672 128,820	2,773 - 2,752 134,077	3,127.0 - 3,112.3 30,048	2,604.9 - 2,581.8 48,846	2,386.2-2,366.1 52,715	2,331.4 - 2,304.3 99,230	1,973.5 - 45.73 500,000	1,595.3 - 1,582.6 50,465	1,044,201 AF
MP, or Active Conserv Storage, AF	3,672.0 - 3,638 39,206	2,752 - 2,720 99,784	3,112.3 - 3,082.4 33,962	2,581.8 - 2,558 27,303	2,366.1 - 2,343 26,846	2,304.3 - 2,280.4 30,517	1,945.73 - 32.5 150,000	1,582.6 - 1,571.7 24,022	431,640 AF
Inactive Storage, AF	3,638.0 - 3,635.5 716	2,720 - 2,710 10,312	3,082.4 - 3,080 1,432	2,558.0 - 2,552 3,736	2,343.0 - 2,335 4,699	2,280.4 - 2,275 2,357	1,932.5 - 1,890 164,111	1,571.7 - 1,562.07 9,985	197,348 AF
Dead Storage, AF	3,635.5 - 3,617 1,418	2,710 - 2,701 2,118	3,080.0 - 3,050 7,516	2,552.0 - 2,527 5,185	2,335.0 - 2,318.5 4,160	2,275.0 - 2,262 1,636	Sluice crest at 1,885 0	1,562.07 - 1,550.0 1,659	23,692 AF
Gross Storage, AF	3,710.0 - 3,617 170,160	2,773 - 2,701 246,291	3,127.0 - 3,050 72,958	2,604.9 - 2,527 85,070	2,386.2 - 2,318.5 88,420	2,331.4 - 2,262 133,740	1,973.5 - 1,890 814,111	1,595.3 - 1,550.0 86,131	1,696,881 AF
Design Sediment Reserve Storage	8,000 AF for 50 years	51,000 AF for 50 years	4,000 AF for 100 years	10,000 AF for 50 years	15,000 AF for 50 years	6,000 AF for 50 years	200,000 AF for 100 yrs	8,000 AF for 50 years	
Measured Sediment Inflow	160 AF/year (estimated)	7,659 AF (1953 to 1982)	1,572 AF (1950 to 1997)	1,616AF (1961 to 1997)	4,397 AF (1949 to 1981)	1,617 AF (1964 to 2000)	38,548 AF (1952 - 00)	6,021 AF (1957 to 1995)	
OUTLET WORKS									at Guide Rock, conc ogee
Location	Left Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	Left Abutment	Center of Dam	Right Abutment	w/2-20'x12' gates to river
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Sluices	Spillway gates used for	5-10'x6'gates to Courtland
Number and Size of Conduit	1 – 56" Cond to 26" Pipe	2 - 6' x 7.5'	1 - 84" Cond to 84"Pipe	1 - 82"	1 – 84" Cond to 44" Pipe	1 – 48" Cond to 38" Pipe	9 - 5'x8' thru Spillway	river releases. Gated	canal (cap 751 cfs), 1-10x6
Length of Conduit, feet	831.5	86.74	516	553.5	553	495 to Gate, 145 to Basin		wasteway with 1-10'x9'	gate to Superior (cap 139).
Entrance Crest Elevation	3,635.5 ft msl	2,710.0 ft msl	3,080.0 ft msl	2,552.0 ft msl	2,335.0 ft msl	2,275.0 ft msl	1,885.0 ft msl	radial gate from outlet	Other private diversion
Disch Cap, Top of Flood Cntrl Pool	140 cfs (approx)	4,300 cfs	1,430 cfs	1,170 cfs	398 cfs (max elev 2,379)	312 cfs	20,700 cfs	canal to stilling basin.	weirs exist on some creeks
Disch Cap, Top of MP (Consv) Pool	103 cfs	3,500 cfs	1,300 cfs	990 cfs	361 cfs	257 cfs	17,370 cfs	Wasteway is not used.	like Riverside blw Enders
Service Gates, Number, Size, Type	1 - 24" Hollow Jet Valve	2 - 6' x 7.5' Slide Gates	2-60" Hollow Jet Valves	2 - 42" Slide Gates	1 - 39" Slide Gate	1 - 33" Slide Gate	9 - 5' x 8' Slide Gates	None	but div capacity minimal.
Provision for Irrigation	1 - 32" Pipe to 24" Valve	1 - 56" Pipe to 4' Gate	None	None	None	None	1-5.5'; 1-2.83' Conduits	1 - 8'x10' Gated Outlet	(5) 13,536 sq mi total
Provision for Power	None	None	None	None	None	None	12'x12' Plug for 9' Cond	None	contributing with u/s dams.
Provision for Municipal Supply	None	None	None	None	None	1 - 16" Pipe to 16" Gate	None	None	ac = acres ft = feet
Other Outlet	1 - 40" Capped Conduit	None	None	None	None	None	1-18" outlet for low flow regulation in mono 20.	Note: Inflow to lake also provided from gated Courtland Canal outlet.	AF = acre-feet
	Notes: Spillway also has 16.5'x21.5' sluice, with 1 - 16.5' x 10.75'gate, crest elev 3,672.0. The 56" gated outlet conduit feeds all three gated sub outlets. Capacity of irrig pipe outlet limited to 34.5 cfs by canal cap.	Notes: Irrigation outlet in right abutment.	Notes: Spillway has an uncontrolled notch w/ crest elevation at 3112.3. Concrete ogee weir diversion dam 52 miles d/s, w/ 2-14' x 9.5' gates plus 30" gated condut to river, and 2- 10'x6' gates to canal (cap 400 cfs).	Note: Concrete ogee weir diversion dam 13 miles downstream, w/ 1-6'x18' radial gate to river, and 2 - 5'x4' regulating gates to canal (max cap 90 cfs) Bartley Diversion Dam located below Rep. R. confluence. See note (4)	Notes: Spillway also has an uncontrolled notch w/ crest elevation at 2366.1. Concrete ogee weir div-ersion dam at mile 301.6 on Rep. R. blw Med Ck. 2-10'x14'gates to river and 4-10'x14' gates to canal (max cap 325 cfs).	Notes: Concrete ogee weir diversion dam 17.6 miles downstream, with 1 – 6'x18' radial gate to river, 2 – 6'x5' gates to Main Canal (cap 100 cfs) and 2 – 5'x4' gates to South Canal (capacity 36 cfs).	Franklin Canal conduit to 2-36" gates, cap 520 cfs. Naponee Canal conduit to 1-24" valve, cap 40 cfs. See also note (4)		cfs = cubic feet per sec msl = elev abv mean sea lvl

SUMMARY OF ENGINEERING DATA
REPUBLICAN RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2D

SUBJECT	WACONDA LAKE	KIRWIN RESERVOIR	WEBSTER RESERVOIR	WILSON LAKE	KANOPOLIS LAKE	CEDAR BLUFF RESERVOIR	REMARKS
GENERAL							(1) With pool at multipurpose or full conservation level.
Location of Dam	Near Glen Elder, KS	Near Kirwin, KS	Near Stockton, KS	Near Wilson, KS	Near Ellsworth, KS	Near Ellis, KS	(2) Damming height is height from original river bed to top of flood control pool.
Stream / River	Solomon River	North Fork Solomon River	South Fork Solomon River	Saline River	Smoky Hill River	Smoky Hill River	(3) Based on latest available storage data. The dates of the current area - capacity tables are indicated below along with the effective dates in parenthesis:
Miles above Mouth	172.4	67.8	92.4	153.9	183.7	333.4	Waconda, July 2001 (effective January 1, 2003)
Contributing Drainage Area, sq miles	2,559 below u/s dams (4)	1,367	1,150	1,917	2,330 blw Cedar Bluff (6)	5,365	Kirwin, May 1996 (effective January 1, 1998)
Approx Length of Full Reservoir, miles (1)	24	9	7	24	12	9	Webster, May 1996 (effective January 1, 1998)
Shoreline, miles (1)	100	37	27	100	41	50	Wilson, December 1984 (effective January 1, 1985)
Maximum Discharge of Record nr Dam Site	125,000 cfs (July 1951)	24,000 cfs (Sep 1919)	55,200 cfs (July 1951)	25,700 cfs (Jul-Aug 1928)	61,000 cfs (June 1938)	98,000 cfs (May 1938)	Kanopolis, February 1983 (effective March 1, 1983)
Date of Closure	October 18, 1967	March 7, 1955	May 3, 1956	September 3, 1963	July 26, 1946	November 13, 1950	Cedar Bluff, March 2001 (effective January 1, 2002)
Date Storage Began	July 24, 1968	October 5, 1955	May 3, 1956	December 29, 1964	February 17, 1948	November 13, 1950	(4) Total DA with Kirwin and Webster = 5,076 sq miles
Date Multipurpose Level Reached	May 16, 1973	July 2, 1957	June 18, 1957	March 12, 1973	July 19, 1948	June 21, 1951	(5) 7’ conduit from intake tower to gate chamber. 4’x5’ emergency gate to 60” pipe. Entrance to stilling well controlled by 4’x5’ slide gate. From stilling well, 42” river outlet pipe controlled by 36” gate. River outlet capacity at top of MP pool and flood control pool about 220 cfs. Length of combined pipes from intake to stilling well about 500’. About 200’ more to stilling basin. Canal releases from two openings at top of stilling well. Canal capacity is about 175 cfs, but combined capacity with river outlet about 395 cfs.
Operating Agency	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Corps of Engineers	Corps of Engineers	Bureau of Reclamation	
DAM AND EMBANKMENT							
Top of Dam Elevation, feet msl	1,500.0	1,779.0	1,944.0	1,592.0	1,537.0	2,198.0	
Length of Dam, feet (Less Spillway)	14,631	12,246	10,604	5,600	15,360	12,409.5	
Damming Height, feet (2)	107.9	95	84.7	114	102	102	
Type of Fill	Earth	Earth	Earth	Earth	Earth	Earth	
Fill Quantity, cubic yards	8,050,000	9,537,000	8,145,000	8,500,000	15,200,000	8,490,000	
SPILLWAY							
Location	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	
Crest Elevation, feet msl	1,467.4	1,757.3	1,884.6	1,582.0	1,507.0	2,166.0	
Width, feet	644	400 (uncontrolled)	116	450 (uncontrolled)	500 (uncontrolled)	150.5 (uncontrolled length)	
Number, Size, and Type of Gates	12 - 50’x21.76’ Radial	None, but see note below	3 – 33.33’x39.51’ Radial	None	None	Gated orifice, see note blw	
Discharge Capacity at Top of Surcharge Pool	278,000 cfs	96,000 cfs (sluices closed)	138,000 cfs	15,700 cfs	172,000 cfs	84,000 cfs (with orifice)	(6) Total contrib. DA with Cedar Bluff = 7,695 sq miles
RESERVOIR (3)							**TOTALS**
Surcharge Pool Elevation (ft msl), Area	1,492.9 ft msl 38,178 ac	1,773.0 ft msl 14,660 ac	1,938.0 ft msl 11,270 ac	1,587.5 ft msl 33,882 ac	1,531.8 ft msl 23,408 ac	2,192.0 ft msl 16,510 ac	137,908 ac
Flood Control Pool Elevation (ft msl), Area	1,488.3 ft msl 33,682 ac	1,757.3 ft msl 10,639 ac	1,923.7 ft msl 8,478 ac	1,554.0 ft msl 20,027 ac	1,508.0 ft msl 13,958 ac	2,166.0 ft msl 10,790 ac	97,574 ac
Multipurpose, or Top Cons Pool Elev, Area	1,455.6 ft msl 12,602 ac	1,729.25 ft msl 5,071 ac	1,892.45 ft msl 3,767 ac	1,516.0 ft msl 9,045 ac	1,463.0 ft msl 3,406 ac	2,144.0 ft msl 6,869 ac	40,760 ac
Inactive Pool Elevation (ft msl), Area	1,428.0 ft msl 3,020 ac	1,697.0 ft msl 1,006 ac	1,860.0 ft msl 904 ac			2,107.8 ft msl 1,907 ac	
Dead Storage Pool Elevation (ft msl), Area	1,407.8 ft msl 248 ac	1,693.0 ft msl 765 ac	1,855.5 ft msl 440 ac			2,090.0 ft msl 755 ac	
Surcharge Storage, AF	1,492.9 - 1,488.3 203,798	1,773.0 - 1,757.3 198,467	1,938.0 - 1,923.7 140,912	1,587.5 - 1,554.0 894,263	1,531.8 - 1,508.0 438,655	2,192.0 - 2,166.0 353,250	2,229,345 AF
Flood Control Storage, AF	1,488.3 - 1,455.6 722,988	1,757.3 - 1,729.25 215,136	1,923.7 - 1,892.45 183,353	1,554.0 - 1,516.0 530,204	1,508.0 - 1,463.0 369,278	2,166.0 - 2,144.0 191,890	2,212,849 AF
MP, or Active Conservation Storage, AF	1,455.6 - 1,428.0 193,183	1,729.25 - 1,697.0 89,639	1,892.45-1,860.0 71,926	1,516.0 - 1,435.0 242,528	1,463.0 - 1,430.0 49,474	2,144.0 - 2,107.8 143,878	790,628 AF
Inactive Storage, AF	1,428.0 - 1,407.8 25,989	1,697.0 - 1,693.0 3,546	1,860.0 - 1,855.5 2,975			2,107.8 - 2,090.0 24,172	56,682 AF
Dead Storage, AF	1,407.8 - 1,395.0 248	1,693.0 - 1,680.0 4,969	1,855.5 - 1,849.0 1,256			2,090.0 - 2,078.0 4,402	10,875 AF
Gross Storage, AF	1,488.3 - 1,395.0 942,408	1,757.3 - 1,680.0 313,290	1,923.7 - 1,849.0 259,510	1,554.0 - 1,435.0 772,732	1,508.0 - 1,430.0 418,752	2,166.0 - 2,078.0 364,342	3,071,034 AF
Design Sediment Reserve Storage	23,750 AF for 50 years	14,950 AF for 100 years	18,600 AF for 100 years	40,000 AF for 100 years	51,500 AF for 50 years	26,000 AF for 100 years	
Measured Sediment Inflow	22,597 AF (1968 to 2001)	1,278 AF (1955 to 1996)	1,267 AF (1956 to 1996)	15,066 AF (1964 to 1995)	28,704 AF (1948 to 1993)	13,044 AF (1950 to 2000)	
OUTLET WORKS							(7) In addition to the gated conduit, Kanopolis has an uncontrolled port opening 3.5’x13.75’ in the 10’ pier separating the two service gate openings. Crest elevation of the port is 1,463 ft msl. The max discharges given for the outlet is the combined total of the port and gates. (8) River outlet crest elev is 2,090 ft msl. Crest elev of sluices under spillway is 2,134.82 ft msl. River outlet capacity at MP is 804 cfs, at top of flood pool is 909 cfs. Cedar Bluff also has an irrig canal outlet on Y junction from river outlet, 5.5’ pipe to control house, canal flow controlled by 4’x5’ gate (not used since 1978, irrigation district disbanded in 1994). Also a hatchery supply line from 18” valve on canal outlet, capacity 10 cfs. Lake storage owned by KS, for benefit of recreation and F&W. All releases coordinated with Kansas KDWP. (9) 2,000 AF annual storage supply contract for Russell.
Location	Left Abutment	Center of Dam	Right Abutment	Right Abutment	Right Abutment	Left Abutment	
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit (7)	Gated Conduit to River	
Number and Size of Conduit	1 - 12.5’	7’ Cond to 60” pipe (5)	4.5’ Conduit to 48” pipe	1 - 12’	1 - 14’	1 - 5.5’	
Length of Conduit, feet	575	(5)	538	1,097	2,443	863.5	
Entrance Crest Elevation	1,407.8 ft msl	1,693 ft msl	1,855.5 ft msl	1,450.0 ft msl	1,415.0 ft msl	2,090.0 ft msl	
Gated Sluice, Number and Size	None	See note below	None	None	None	8 - 5’x5’, gated (8)	
Discharge Cap, Top of Flood Control Pool	5,200 cfs	220 cfs (5)	480 cfs	6,500 cfs	6,400 cfs (7)	3,520 cfs (outlet, sluices) (8)	
Disch Cap, Top of MP (Conservation) Pool	4,000 cfs	220 cfs (5)	385 cfs	5,300 cfs	4,500 cfs (7)	7,949 cfs (outlet, sluices) (8)	
Service Gates, Number, Size, Type	2 - 6.5’x8’ Slide Gates	1 - 4’x5’ to stilling well (5)	1 - 3.5’x3.5’ Slide Gate	2 - 6’x12’ Service Gates	2 - 6’x12’	1 - 4’x5’	
Emergency Gates, Number and Size	1 - 9’x12’ Slide Gates	1 - 4’x5’ (5)	1 - 3.5’x3.5’ Slide Gate	2 - 6’x12’ Slide Gates	1 - 6’x12’	1 - 4’x5’	
Low Flow Gates, Number and Size	None	None	None	2 - 2’x2’ Slide Gates	None	None	
Provision for Irrigation	None	2 - 5.5’x8’ openings (5)	None	None	None	1 - 4’x5’ (8)	
Provision for Power	None	None	None	None	Provision future penstock	None	
Provision for Municipal Supply	No pipe outlets, water supply released to river	None	None	None	Pump outlet near tower	See (9), supplied by release to river, pump to Big Ck.	
		Note: 15 - 5’ x 5’ gated sluices located in concrete ogee section below spillway crest. Crest elevation at sluice entrance = 1,720.0. Discharge capacity at top of conserv pool = 4,800 cfs, top, flood pool = 15,350 cfs.	Note: When reservoir elevation is below 1,860, the outlet gate openings must be reduced to prevent air entrainment in conduit.	Note: Low flow gates are mounted in the service gates		Note: Spillway also has a gated orifice section at center with 1 - 14.5’ x 9.58’ radial gate, crest elev 2,144. Spillway cap includes ogee and orifice. Sluices located in ogee section below crest.	

Abbreviations
ac = acres
AF = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second
MP = multipurpose pool elevation

SUMMARY OF ENGINEERING DATA
SMOKY HILL RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2E

APPENDIX A
CORPS OF ENGINEERS PROJECTS

BLUE SPRINGS LAKE

CLINTON LAKE

HARLAN COUNTY LAKE

HARRY S TRUMAN RESERVOIR

HILLSDALE LAKE

KANOPOLIS LAKE

LONG BRANCH LAKE

LONGVIEW LAKE

MELVERN LAKE

MILFORD LAKE

PERRY LAKE

POMME DE TERRE LAKE

POMONA LAKE

RATHBUN LAKE

SMITHVILLE LAKE

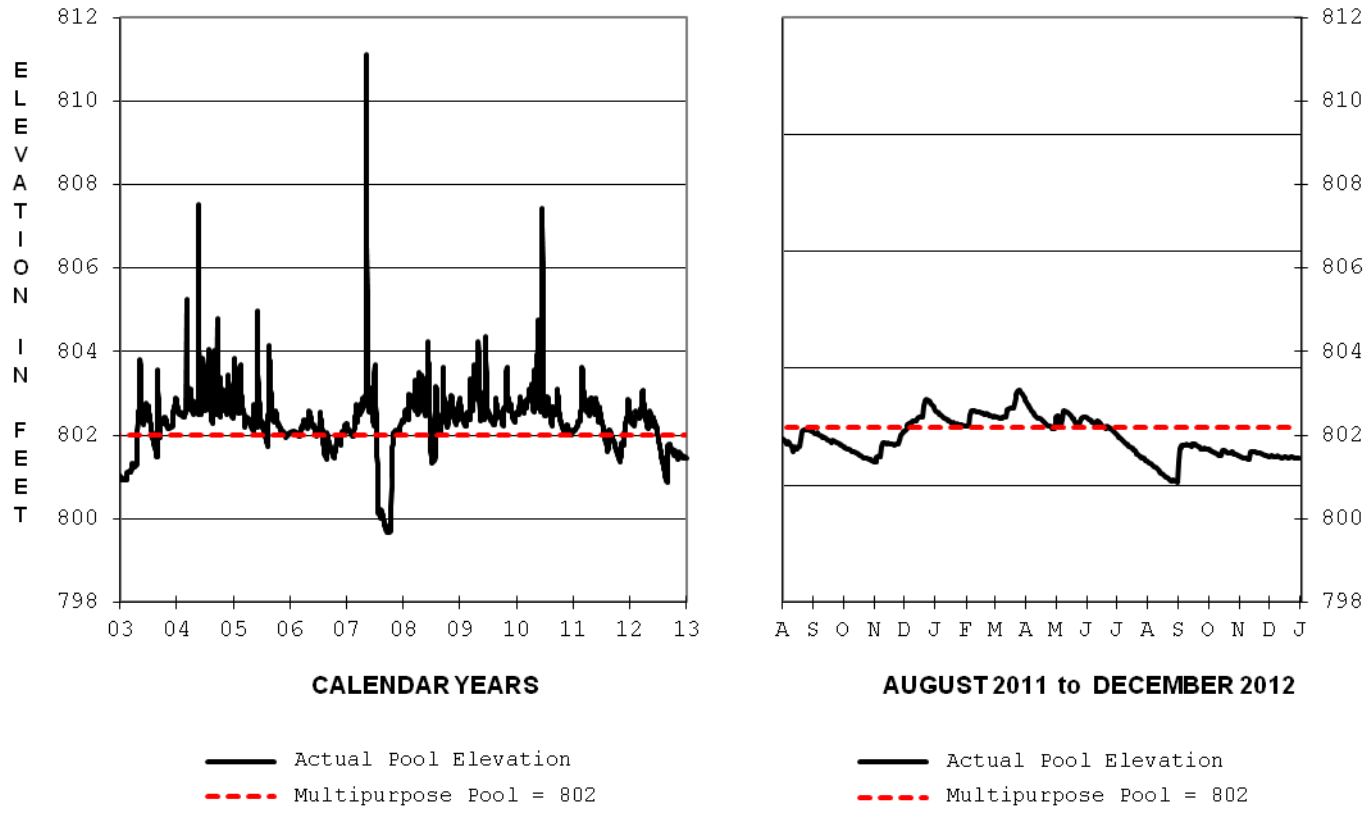
STOCKTON LAKE

TUTTLE CREEK LAKE

WILSON LAKE

BLUE SPRINGS LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

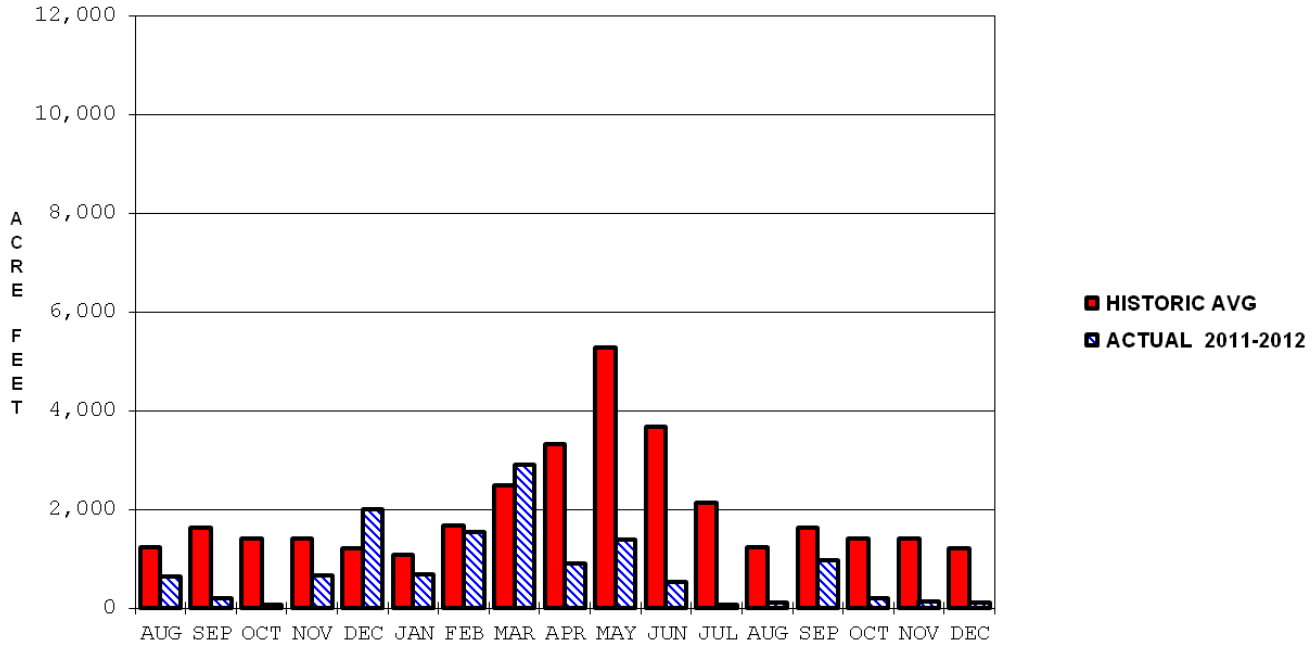


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
801.90 1 Aug 11	**801.45 31 Dec 12**	**803.07 24 Mar 12**	**800.87 27 Aug 11**	**816.37 16-17 May 90**	**799.69 7 Oct 07**

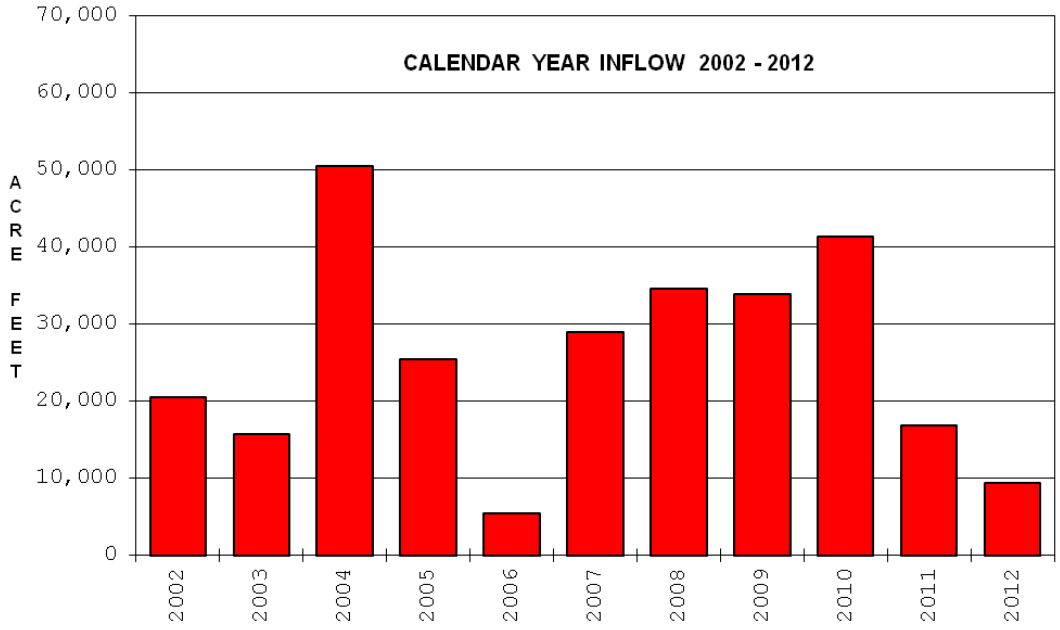
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
225 1 Sep 12	**12,977**	**86 25 Mar 12**	**0 Many days**

All releases are to the river. No minimum release requirement. No release when lake below notch elevation 802.0

BLUE SPRINGS LAKE MONTHLY INFLOW

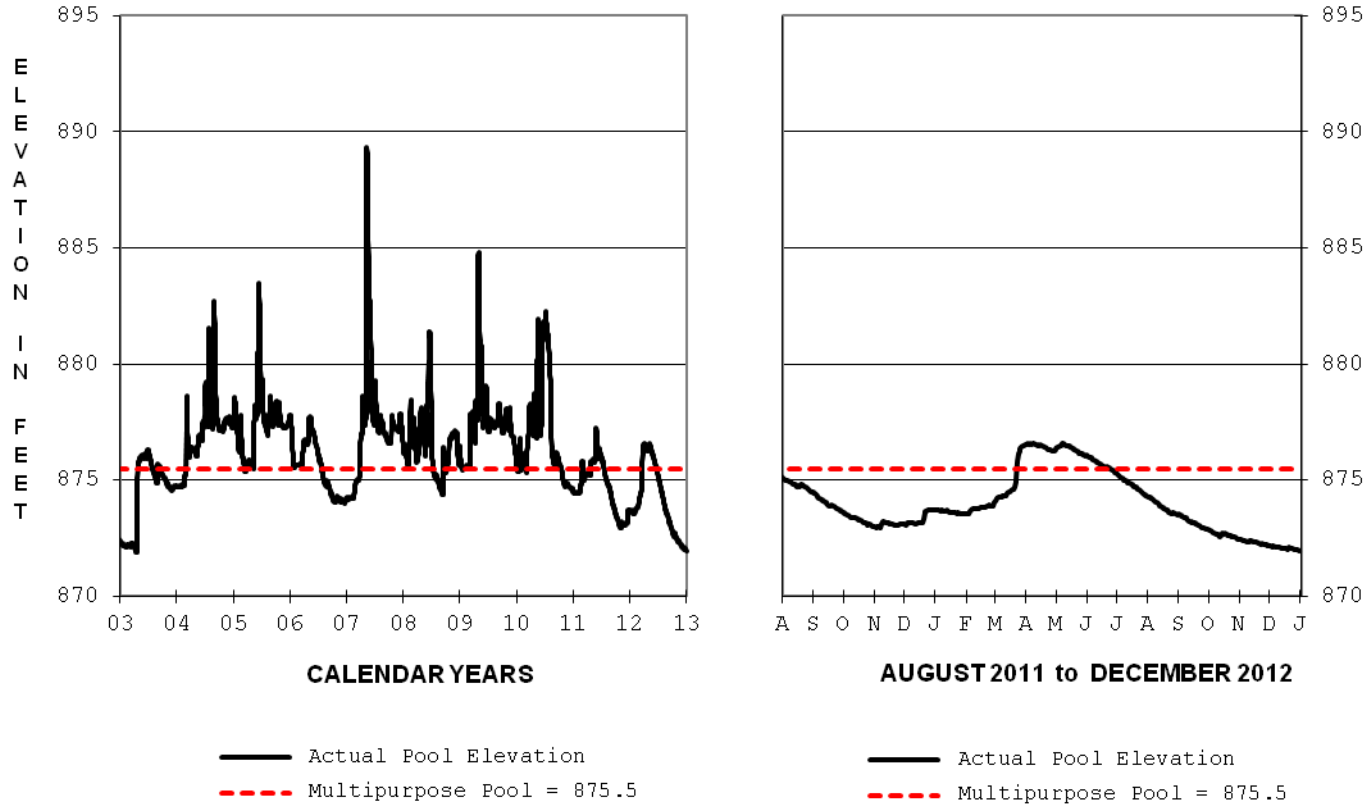


BLUE SPRINGS LAKE ANNUAL INFLOW



CLINTON LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

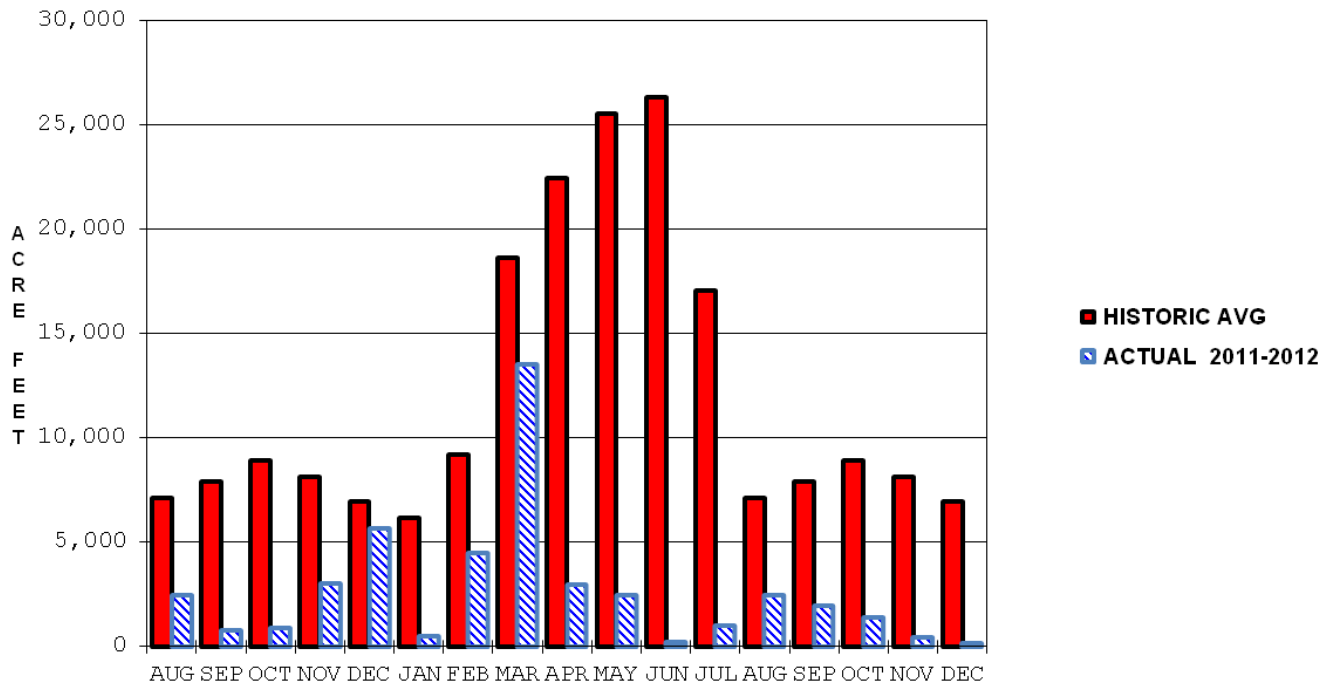


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
875.07 1 Aug 11	**871.96 31 Dec 12**	**876.57 5 Apr 12**	**871.96 31 Dec 12**	**892.48 29 May 95**	**871.60 18-19 Aug 89**

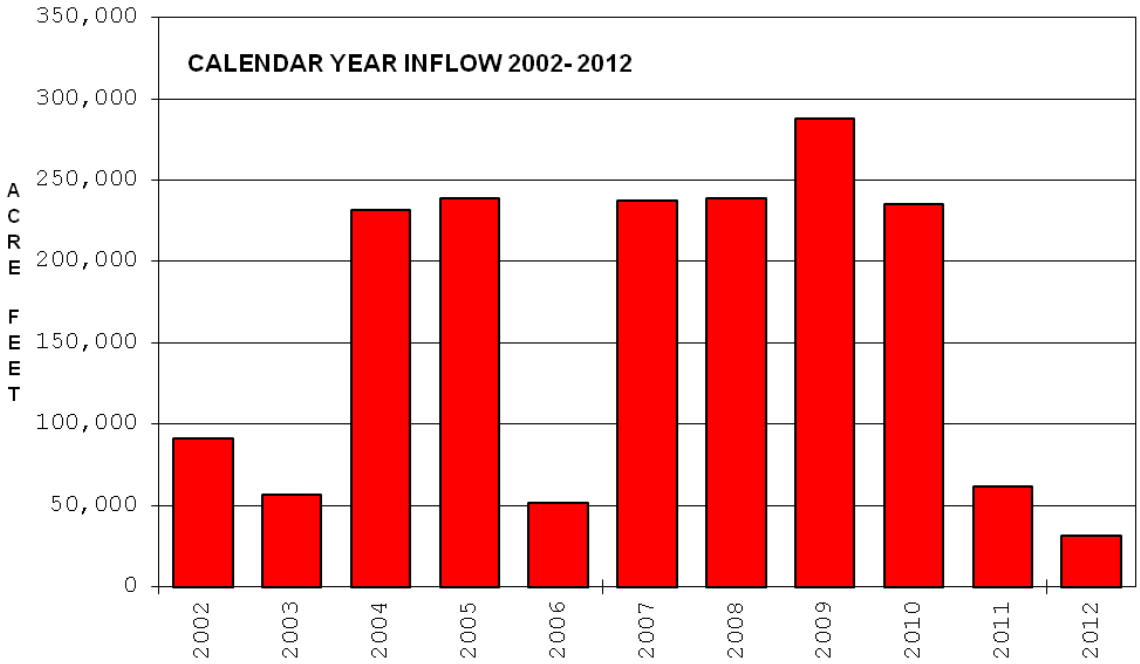
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,000 23 Mar 12	**45,007**	**70 30 Mar 12**	**7 many**

Outflows are those to river only. Minimum release is 7 to 21 cfs. Releases cut to 0 for maintenance, inspections.

CLINTON LAKE MONTHLY INFLOW

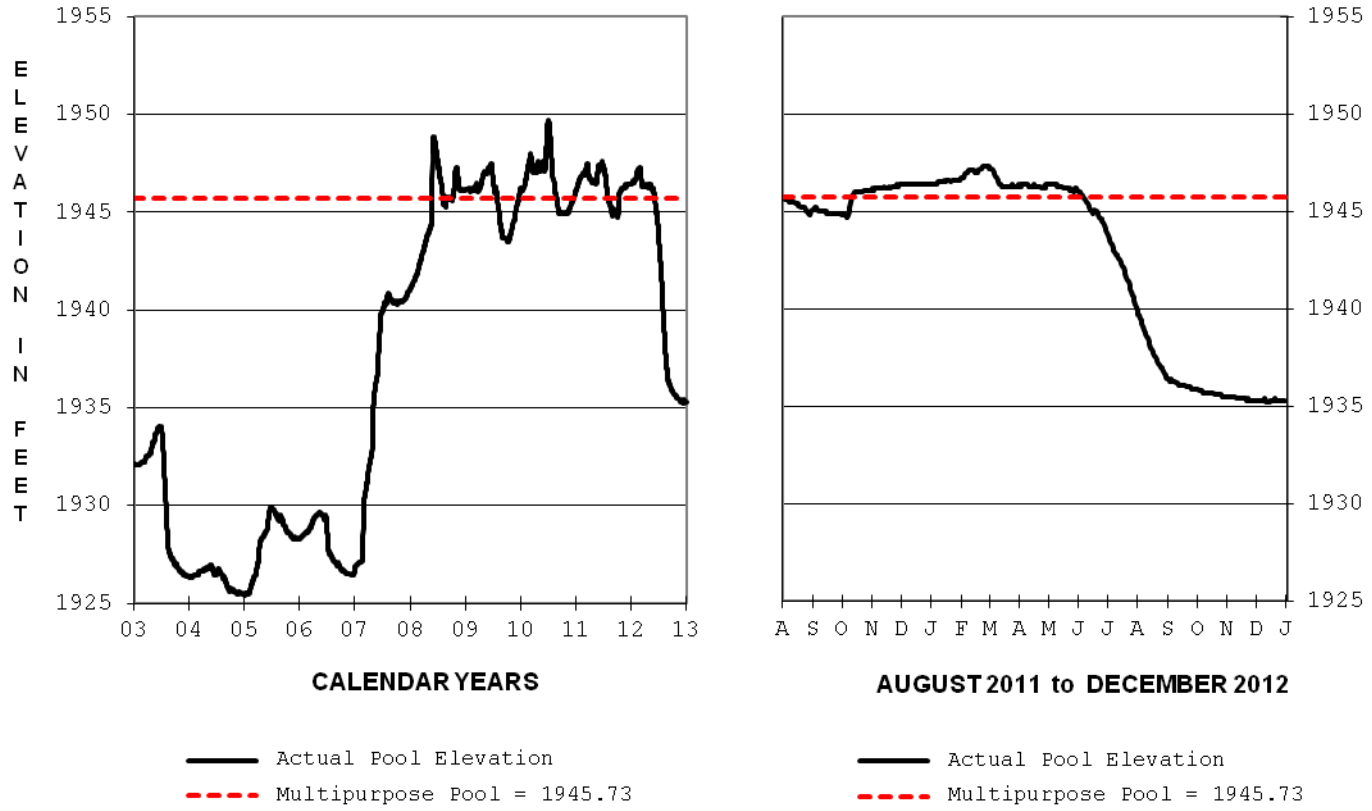


CLINTON LAKE ANNUAL INFLOW



HARLAN COUNTY LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

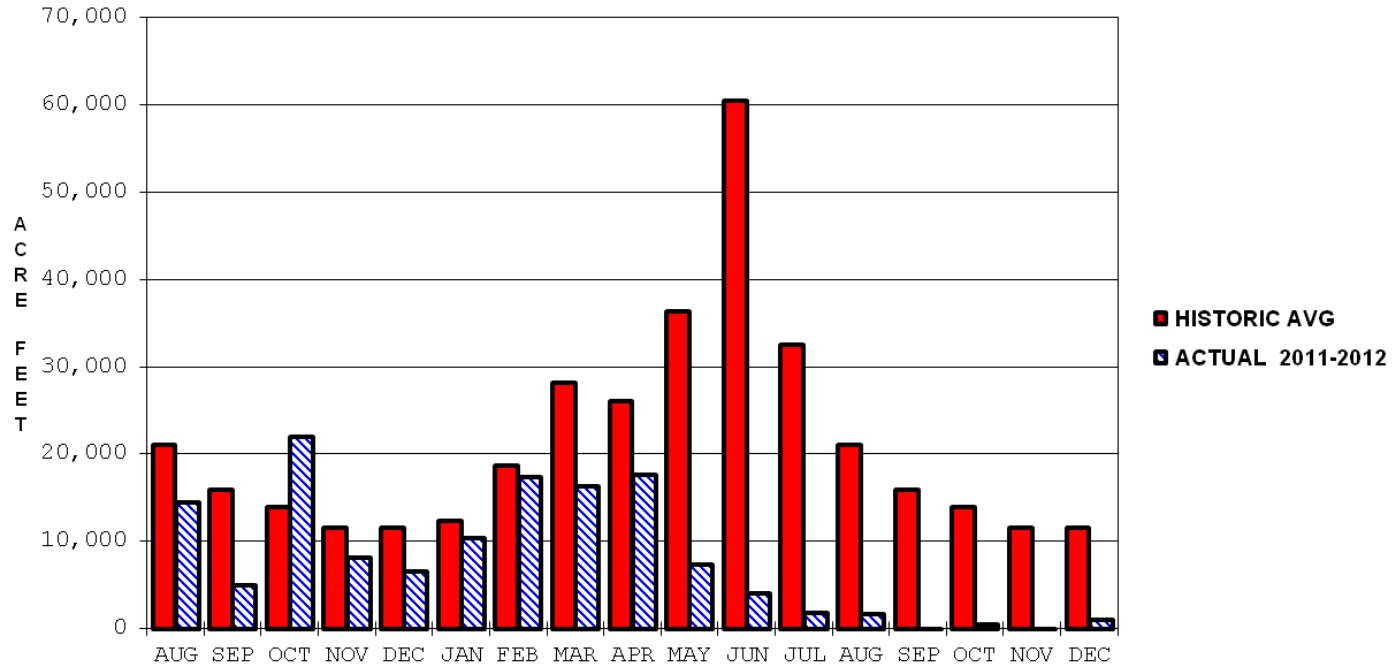


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1945.74 1 Aug 11	**1935.28 31 Dec 12**	**1947.33 24 Feb 12**	**1935.20 14 Dec 12**	**1955.66 5 Apr 60**	**1925.38 31 Dec 04**

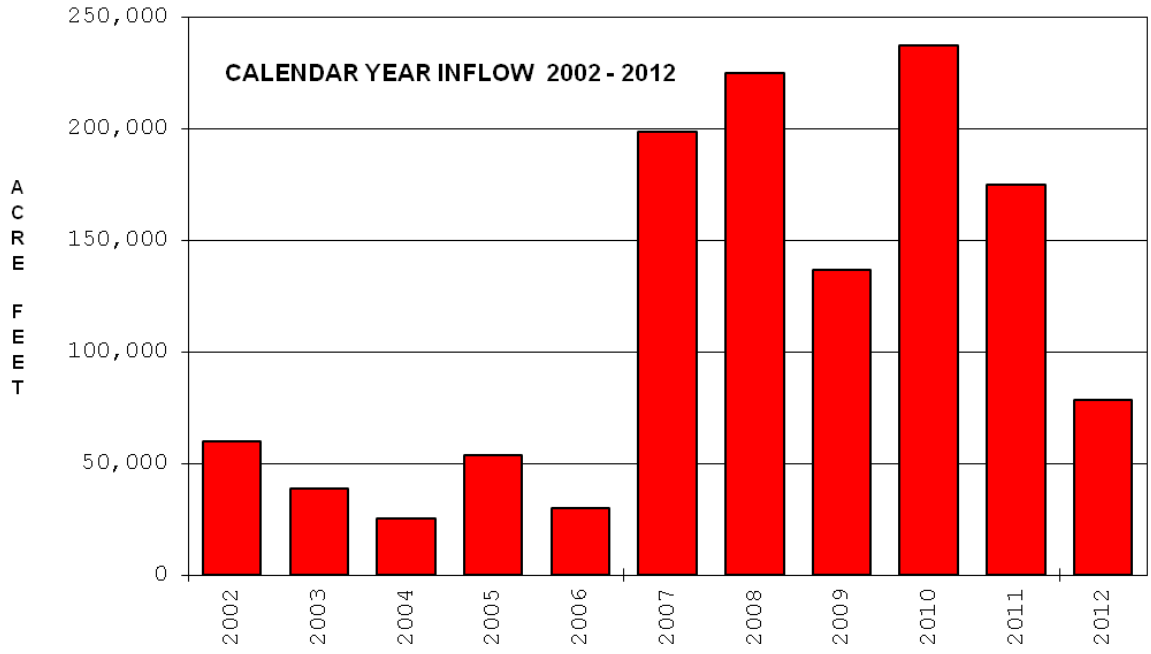
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,000 10 Oct 11	**134,028**	**1000 7 Mar 12**	**0 Many Days**

Max daily outflow to river normally occurs as part of normal releases for irrigation. No minimum release requirement.

HARLAN COUNTY LAKE MONTHLY INFLOW

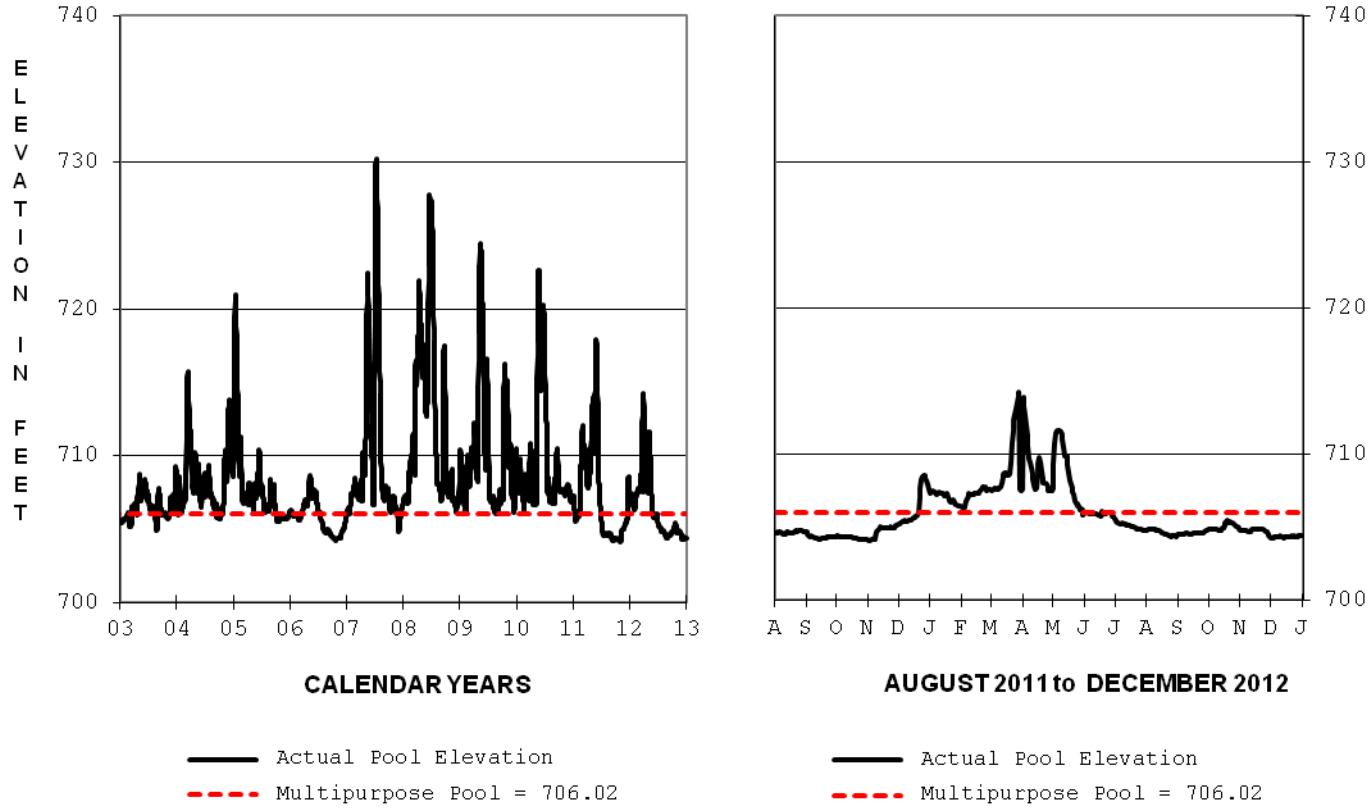


HARLAN COUNTY LAKE ANNUAL INFLOW



HARRY S TRUMAN RESERVOIR
2011 - 2012 REGULATION

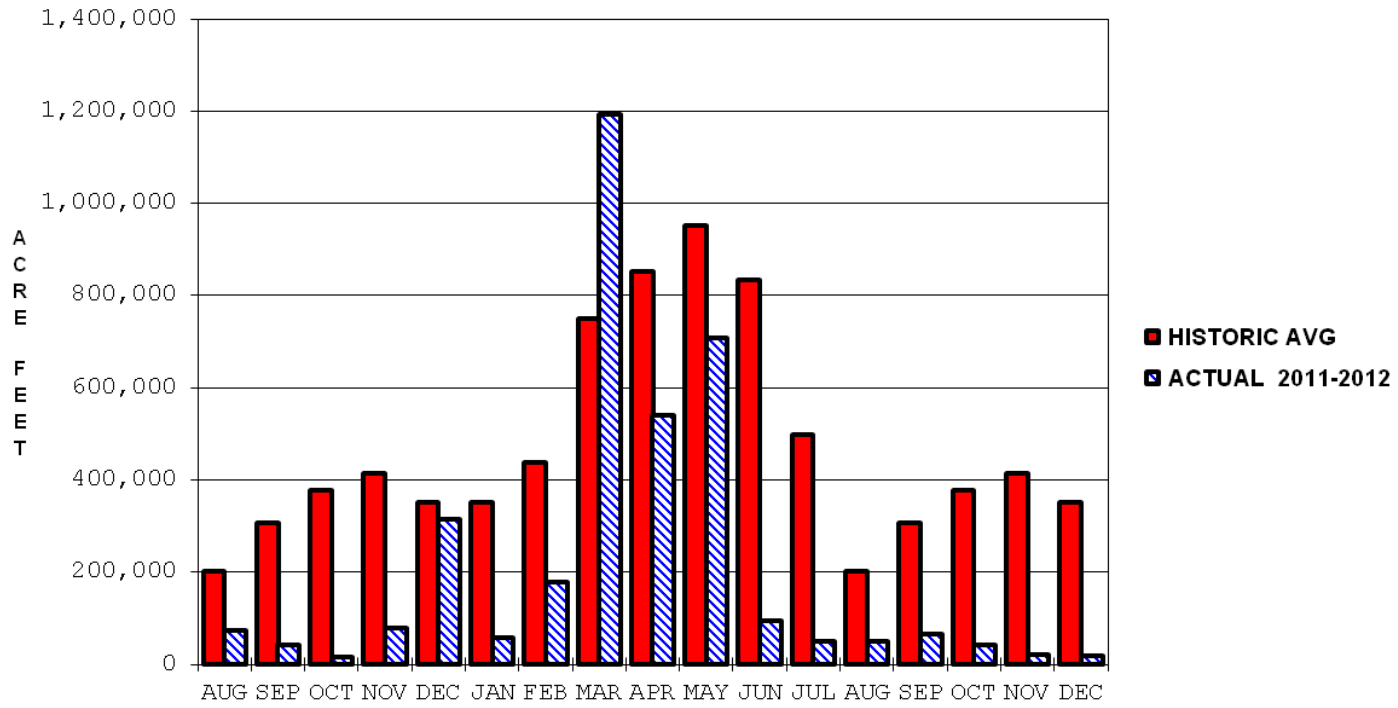
A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



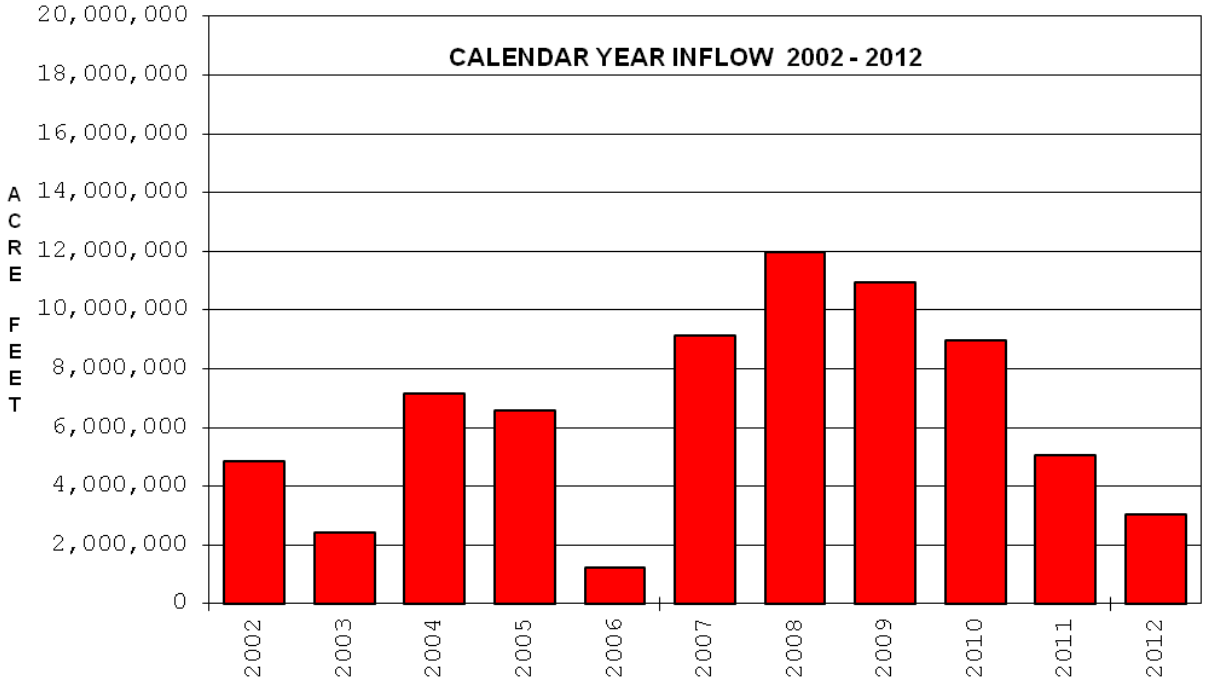
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
704.57 1 Aug 11	**704.39 31 Dec 12**	**714.41 30 Mar 12**	**704.09 2 Nov 11**	**738.72 12 Oct 86**	**703.42 10 Apr 81**

Report Period Inflow and Outflow			
Max Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
62,993 1 May 12	**3,474,643**	**12,020 24 Dec 11**	**0 Many days**
No minimum release requirement.			

HARRY S. TRUMAN RESERVOIR MONTHLY INFLOW

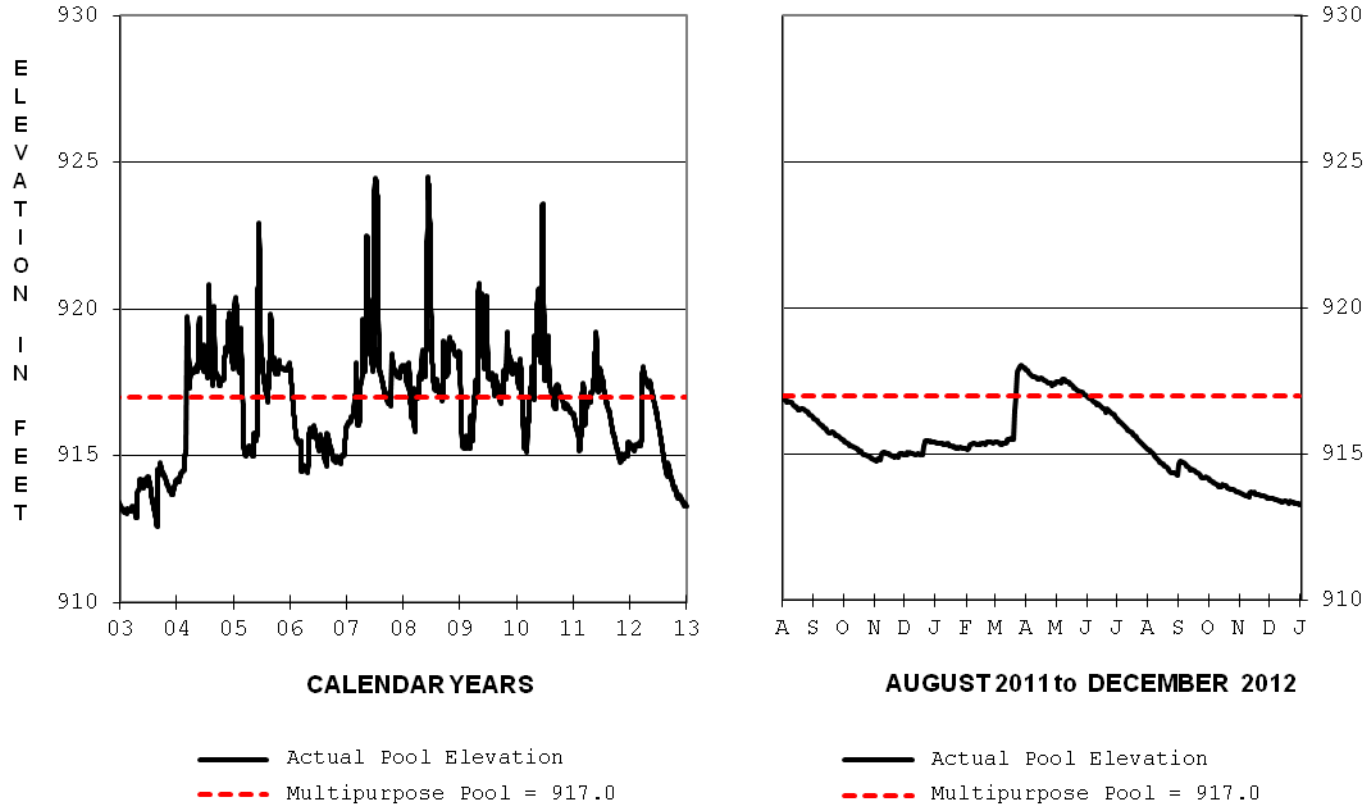


HARRY S. TRUMAN RESERVOIR ANNUAL INFLOW



HILLSDALE LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

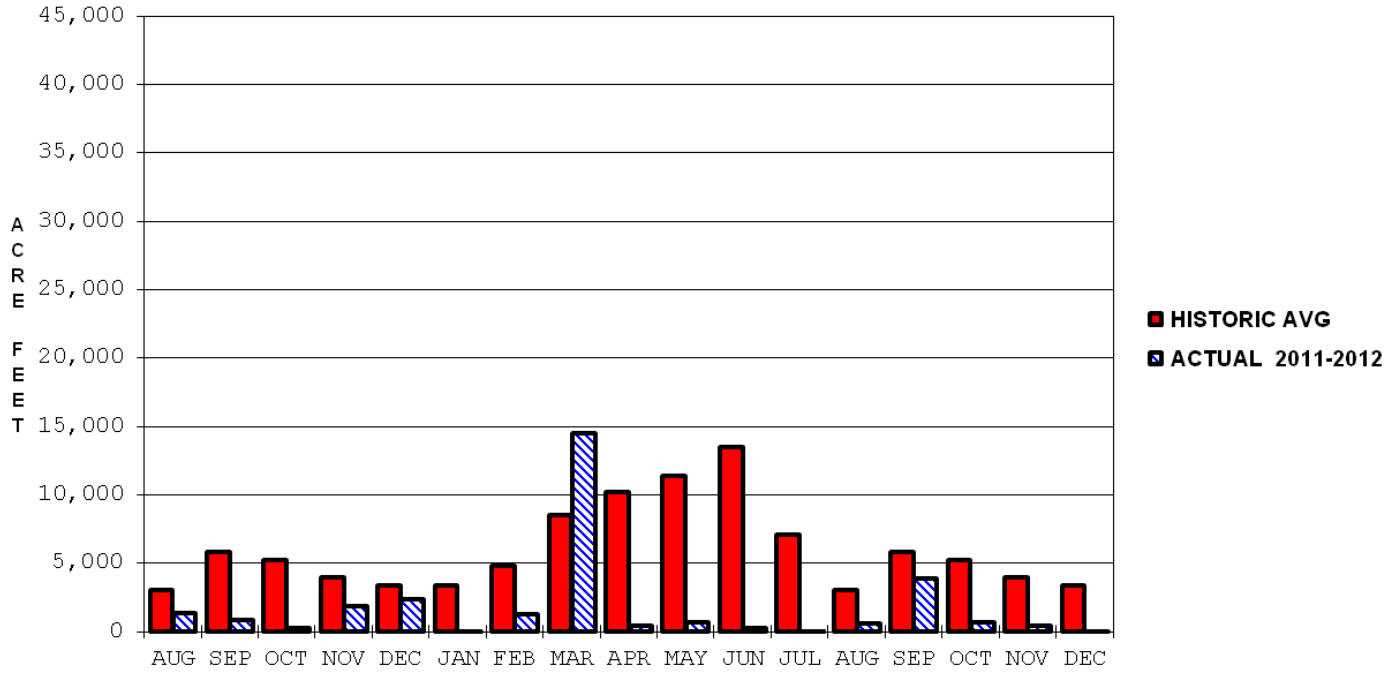


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
916.92 1 Aug 11	**913.28 31 Dec 12**	**918.02 27 Mar 12**	**913.28 31 Dec 12**	**928.51 21 Oct 86**	**904.97 14-15 Nov 87**

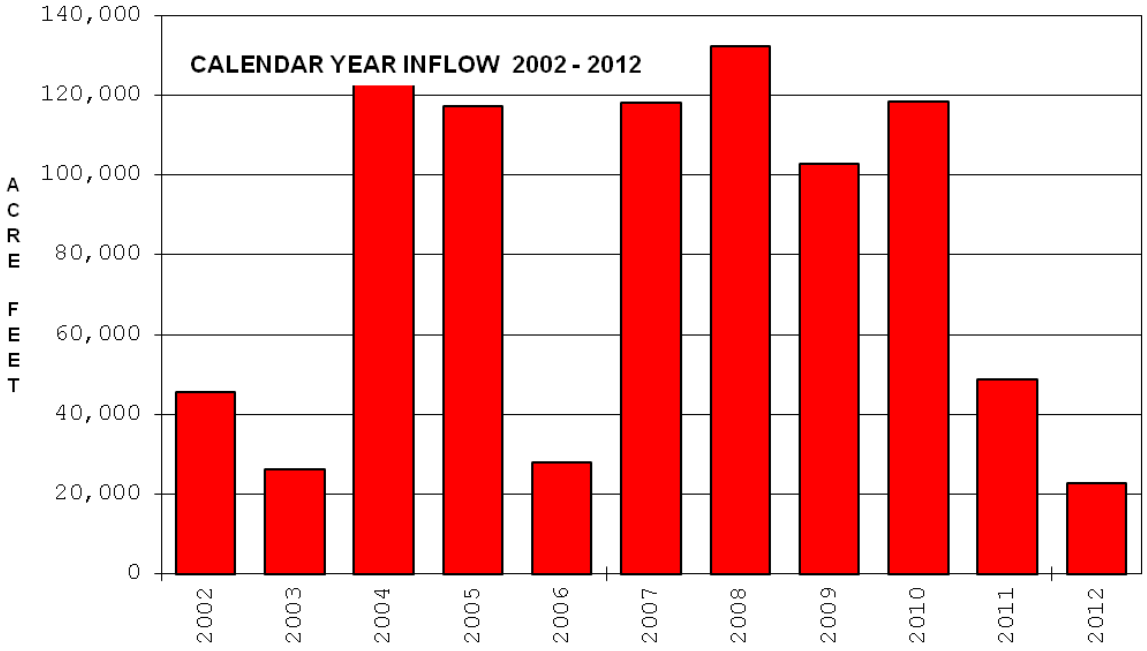
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,600 21 Mar 12	**29,523**	**100 28 Mar 12**	**3 Many days**

Minimum required release varies seasonally 3 to 24 cfs. Releases cut to 0 for maintenance and inspections.

HILLSDALE LAKE MONTHLY INFLOW

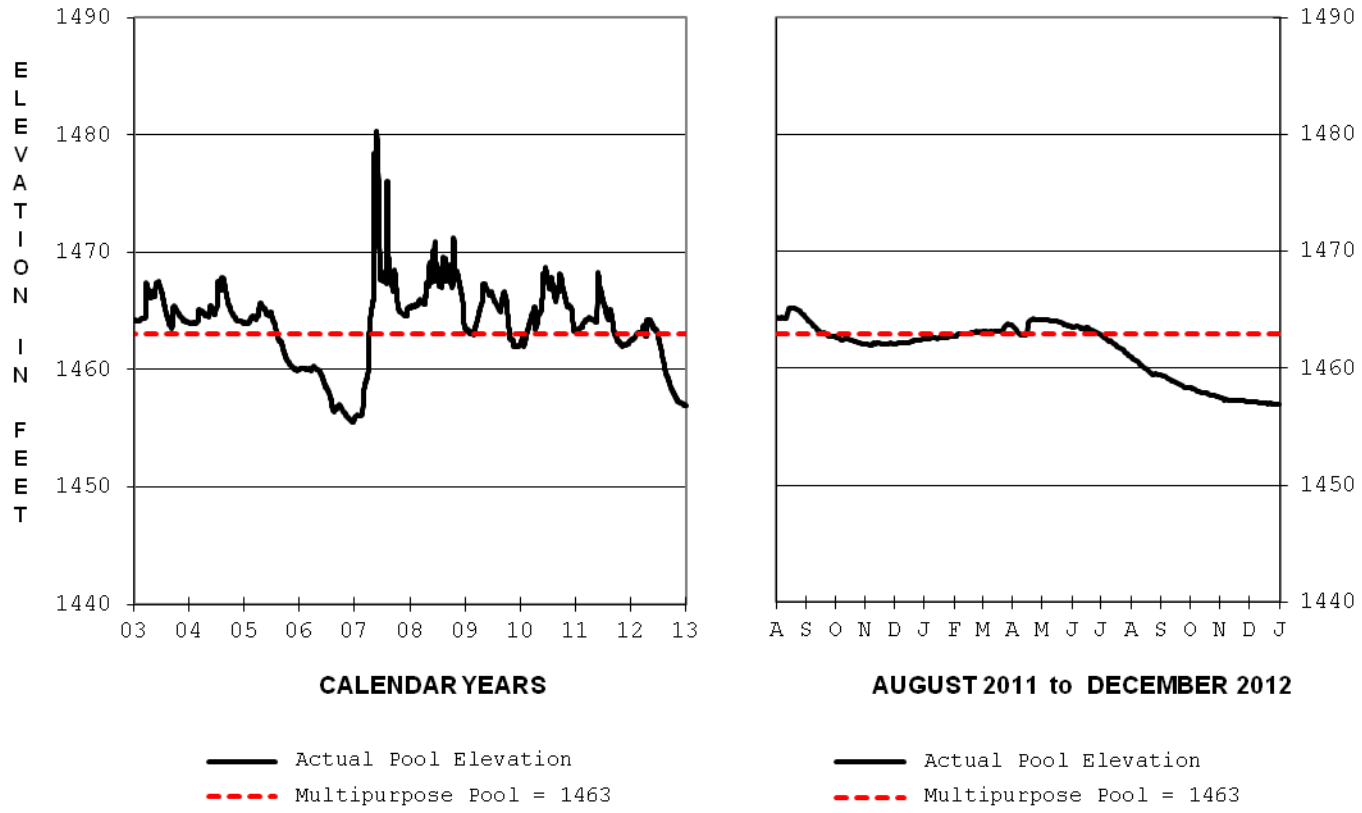


HILLSDALE LAKE ANNUAL INFLOW



KANOPOLIS LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

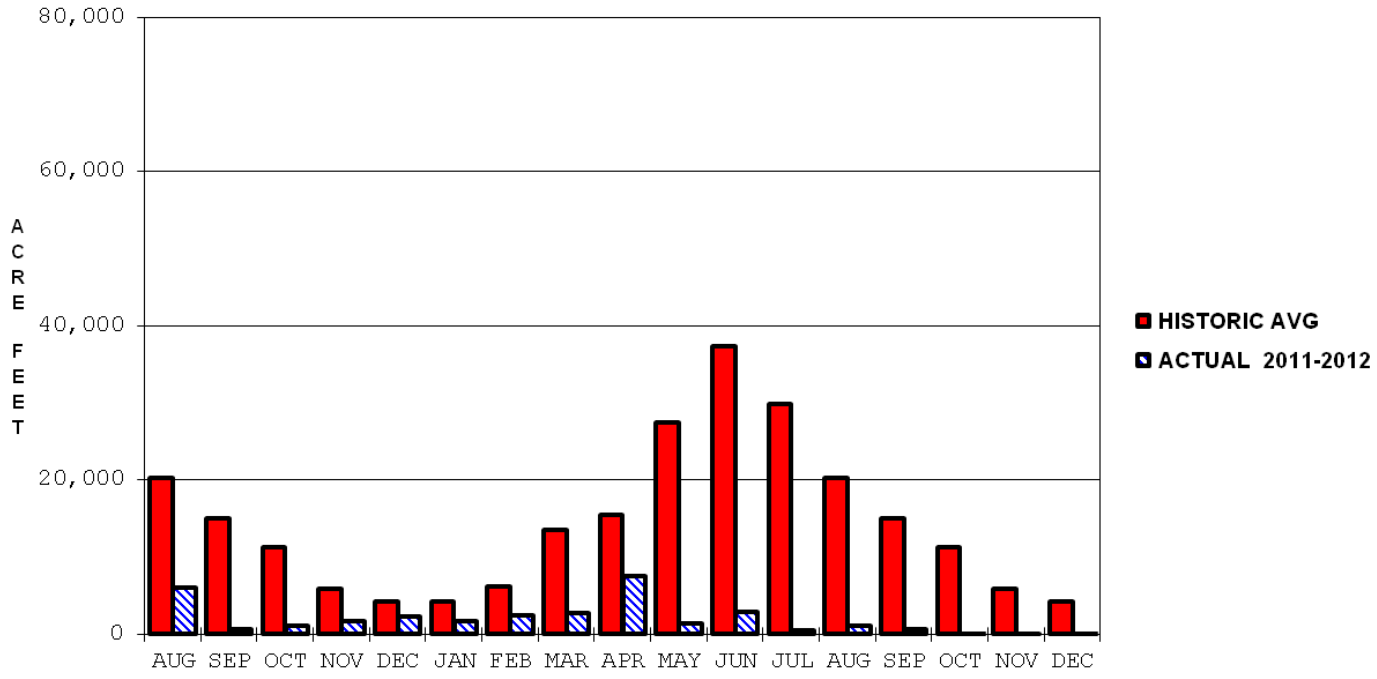


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1464.42 1 Aug 11	**1456.85 31 Dec 12**	**1464.26 22 Apr 12**	**1456.85 31 Dec 12**	**1506.98 14 Jul 51**	**1452.55 11 Dec 88**

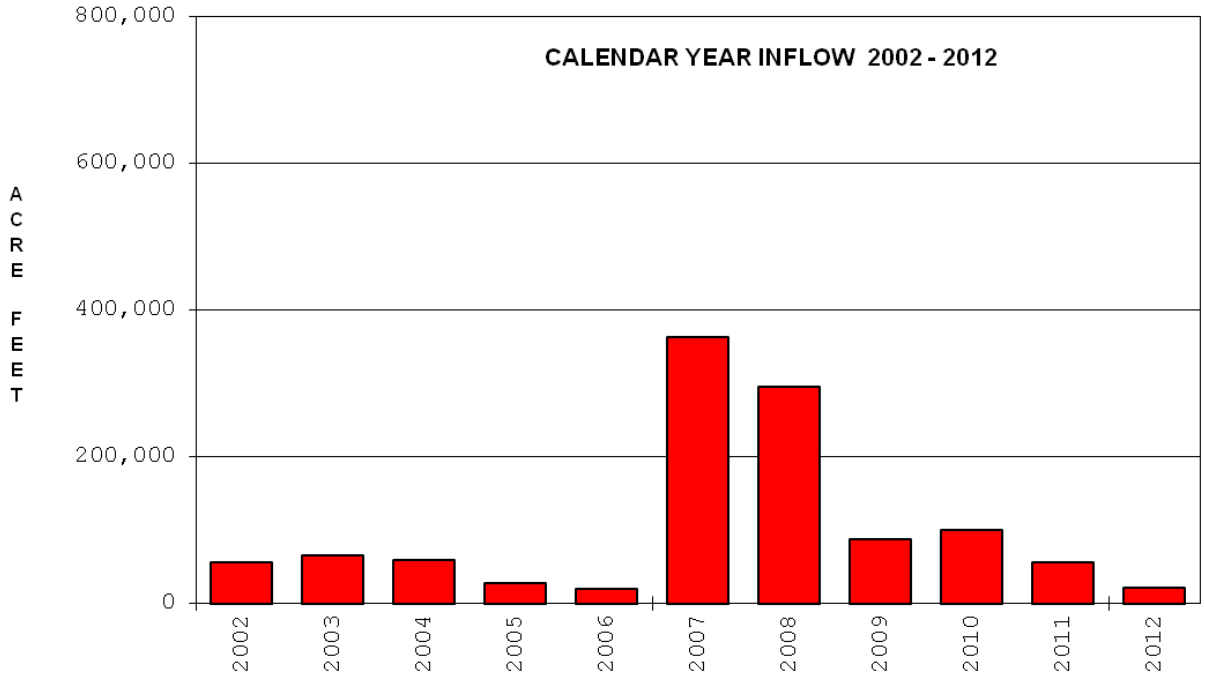
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
700 12 Aug 11	**32,787**	**229 4 Apr 12**	**0 11 Apr 12**

Outflows are total from the gates and the uncontrolled notch. Minimum release varies seasonally 10 to 50 cfs.

KANOPOLIS LAKE MONTHLY INFLOW

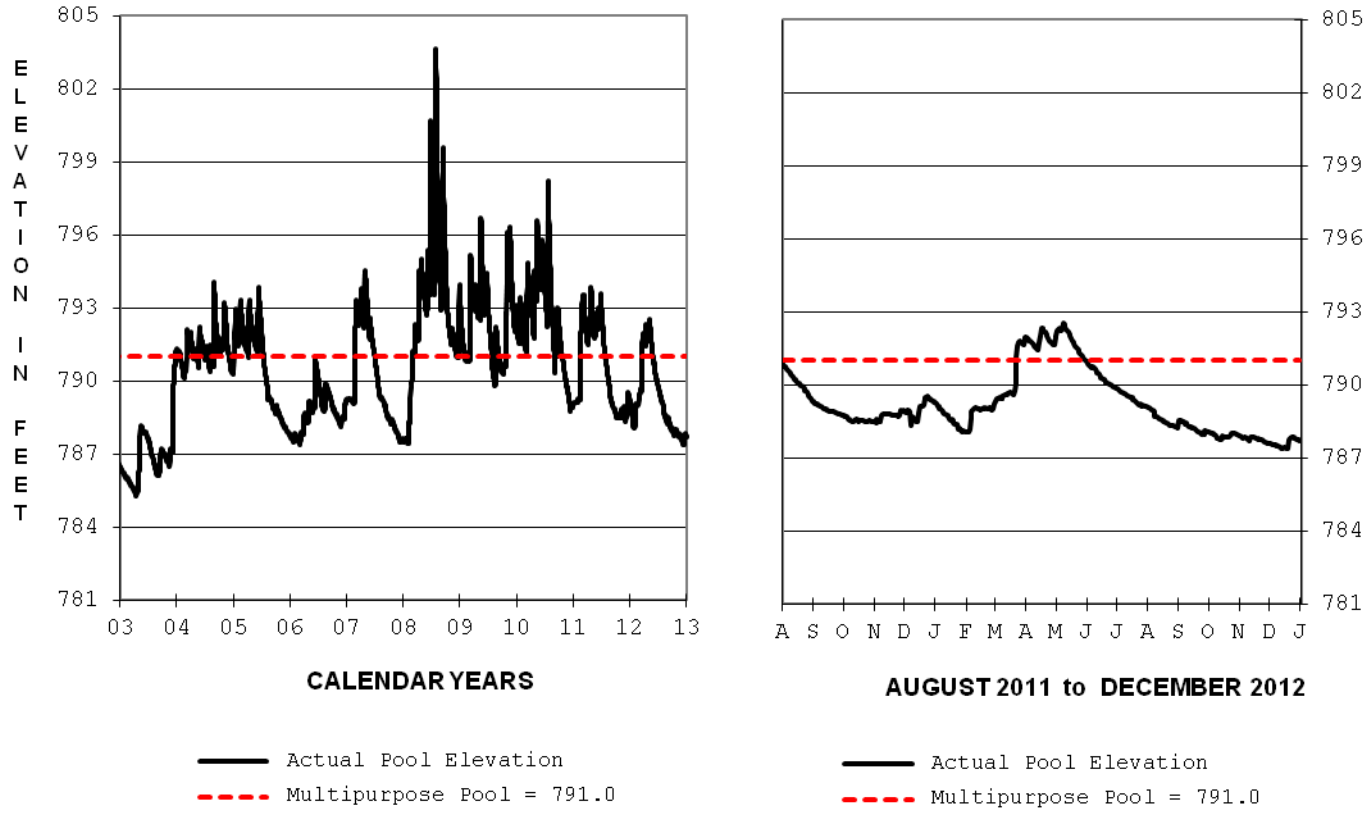


KANOPOLIS LAKE ANNUAL INFLOW



LONG BRANCH LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

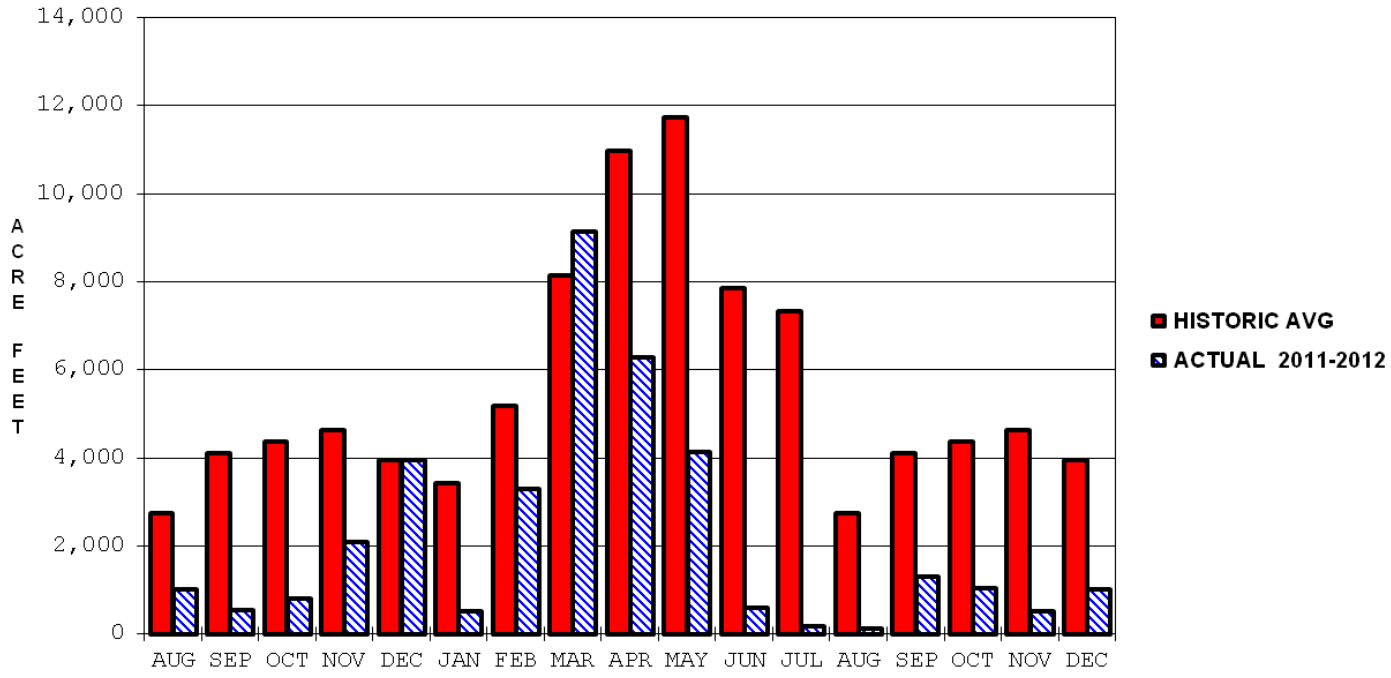


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
790.84 1 Aug 11	**787.72 31 Dec 12**	**792.54 8 May 12**	**787.39 18 Dec 12**	**803.64 30 Jul 08**	**783.70 12 Jan 01**

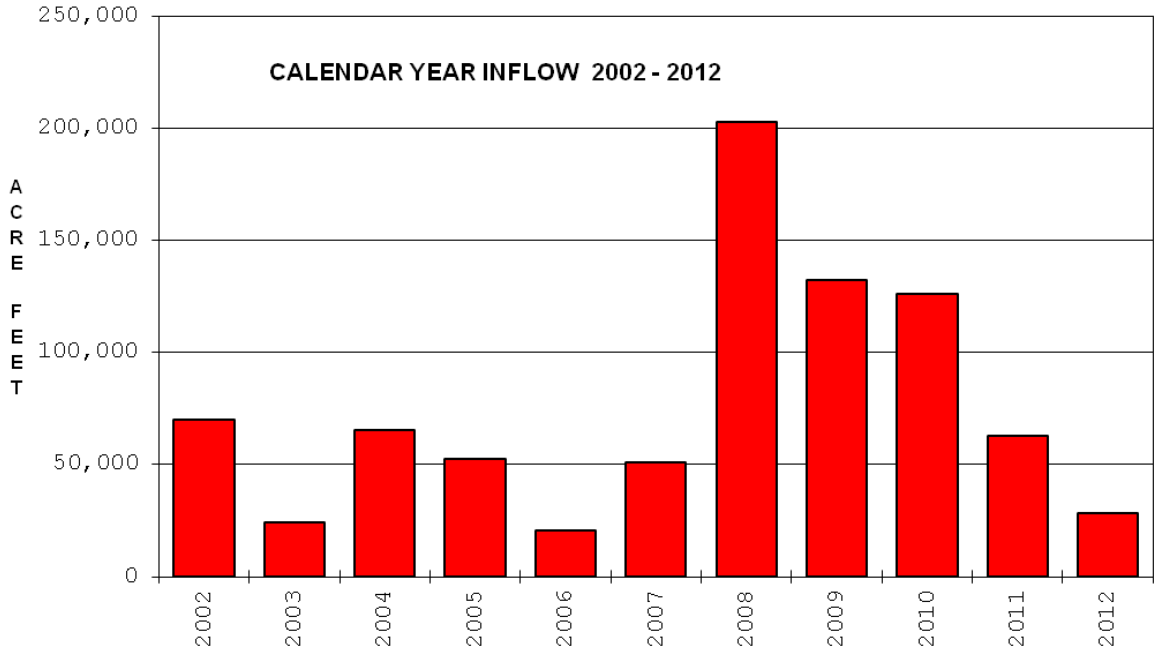
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
800 22 Mar 12	**36,428**	**148 9 May 12**	**7 many**

Listed outflows are total to the river from the gates and the uncontrolled notch. Min req release is normally 7 cfs.

LONG BRANCH LAKE MONTHLY INFLOW

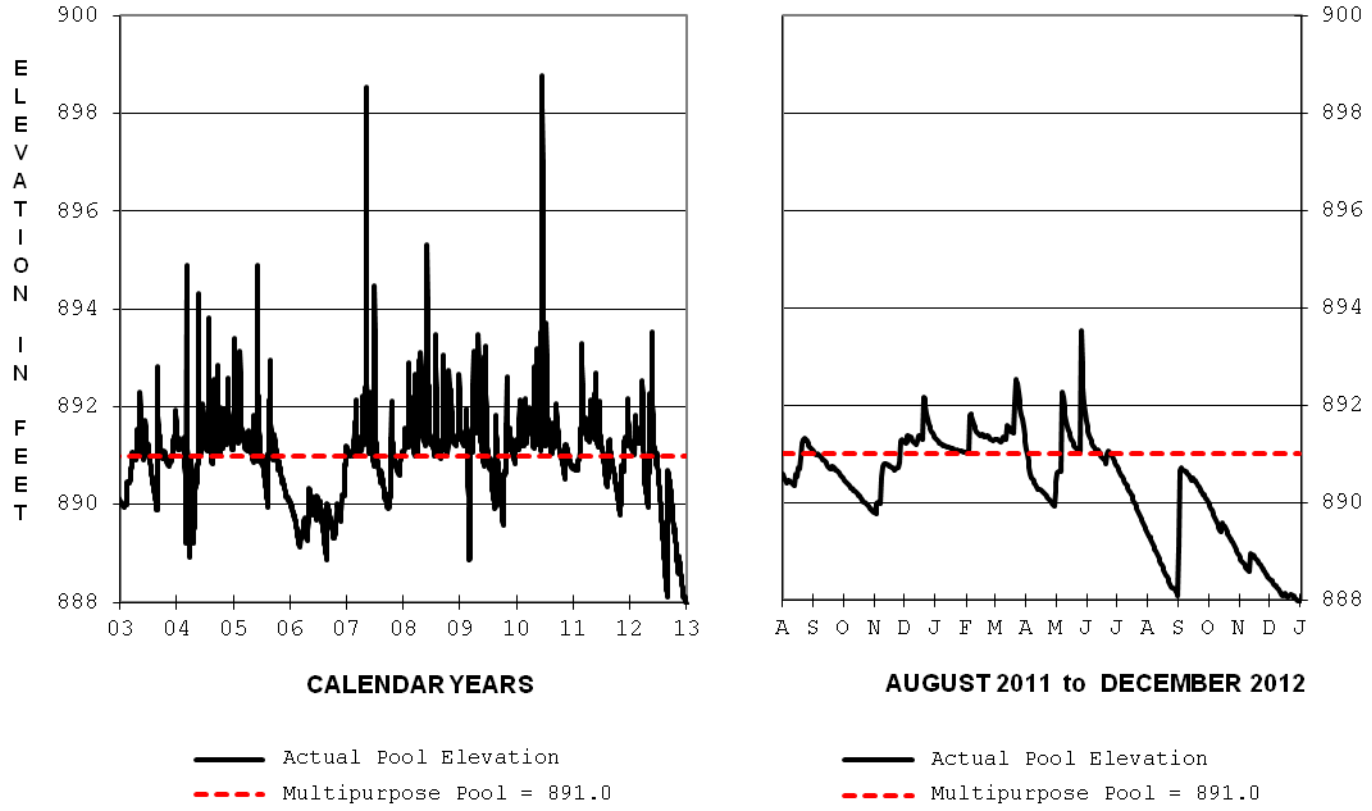


LONG BRANCH LAKE ANNUAL INFLOW



LONGVIEW LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

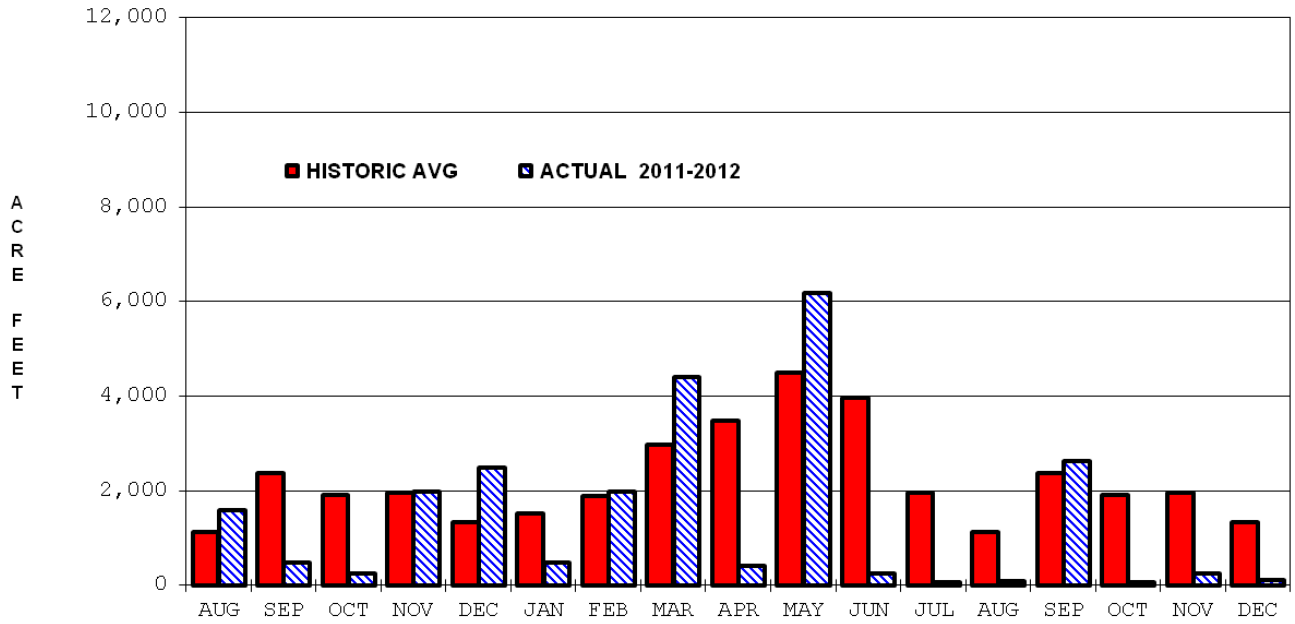


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
890.58 1 Aug 11	**887.96 31 Dec 12**	**893.53 26 May 12**	**887.96 31 Dec 12**	**903.37 16 May 90**	**887.96 31 Dec 12**

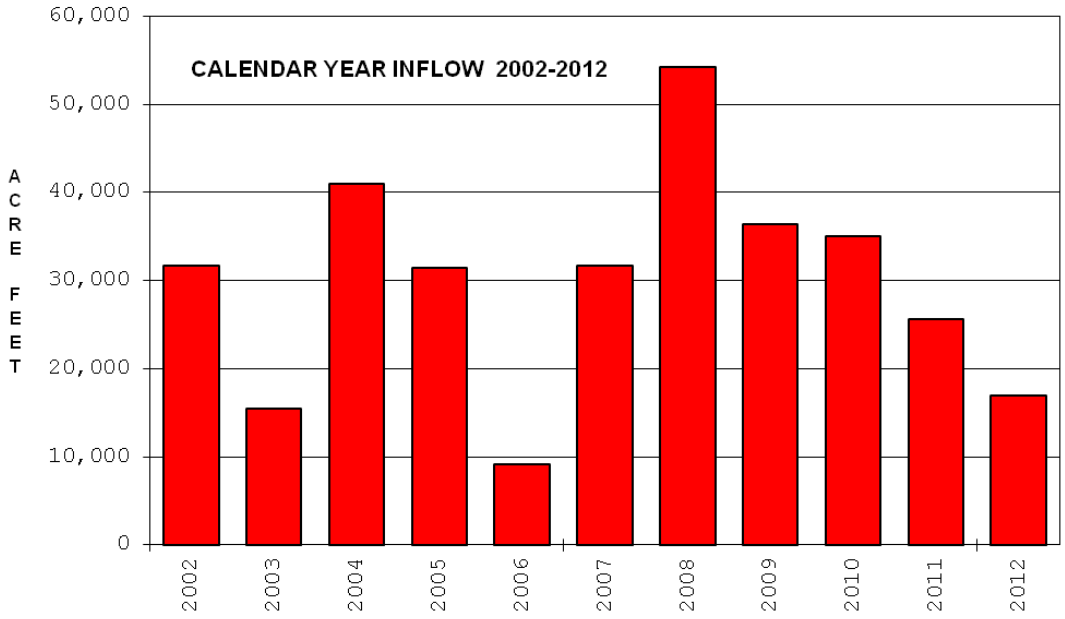
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,200 26 May 12	**23,995**	**449 27 May 12**	**8 Many Days**

Listed outflows are total to the river from the gate and the uncontrolled notch. Minimum required release is 8 cfs.

LONGVIEW LAKE MONTHLY INFLOW

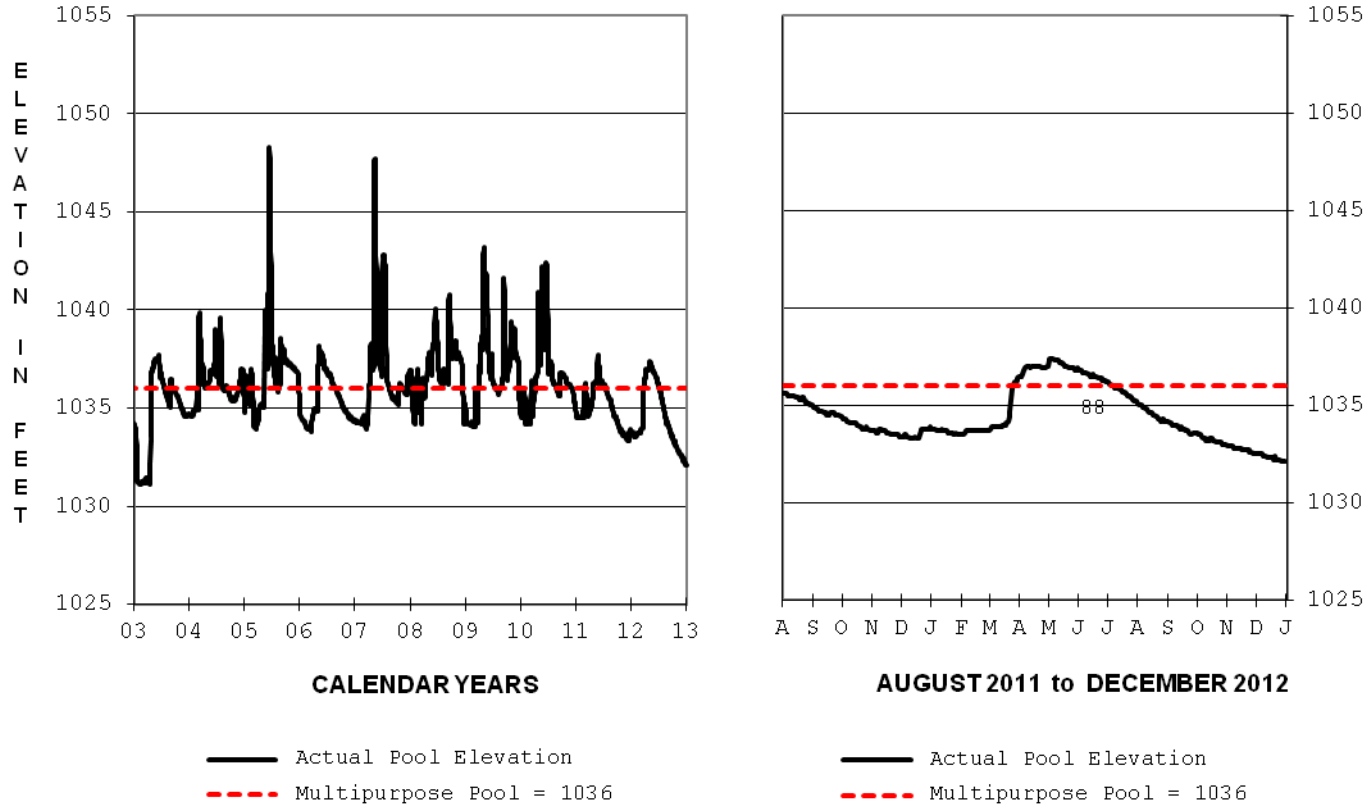


LONGVIEW LAKE ANNUAL INFLOW



MELVERN LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

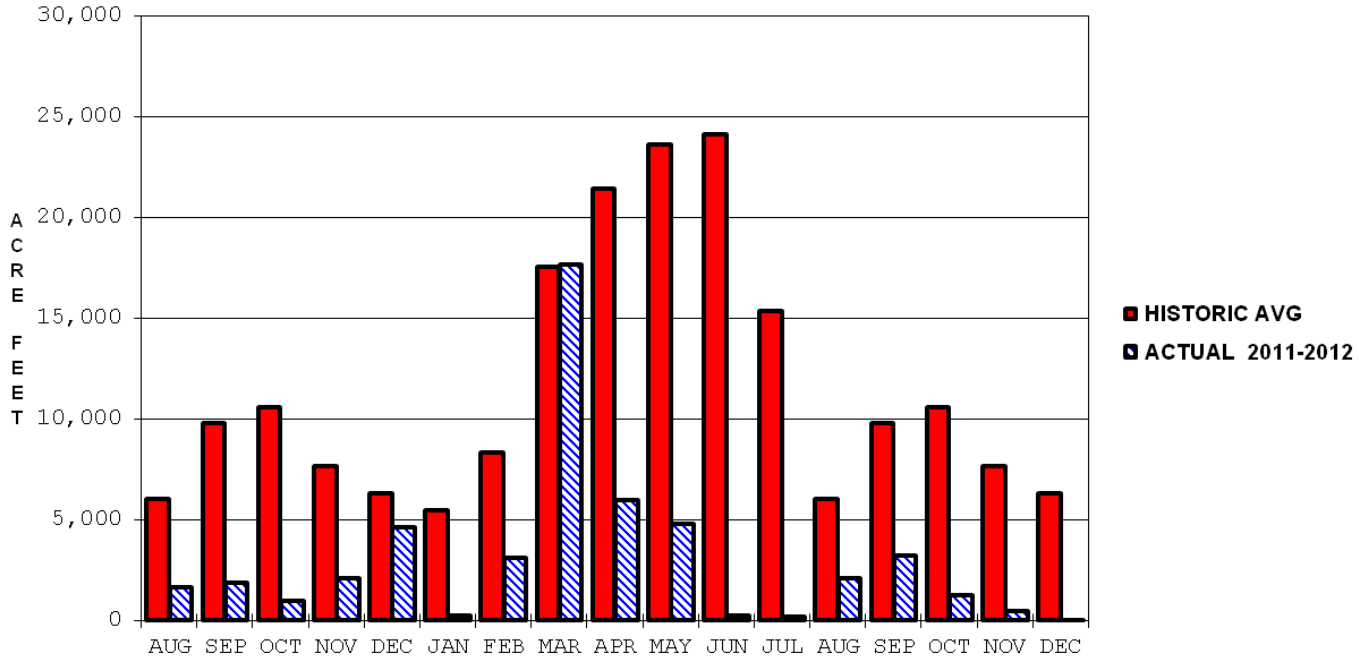


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1035.64 1 Aug 11	**1032.05 31 Dec 12**	**1037.42 3 May 12**	**1032.05 31 Dec 12**	**1053.45 13 Jun 95**	**1029.87 11 Feb 92**

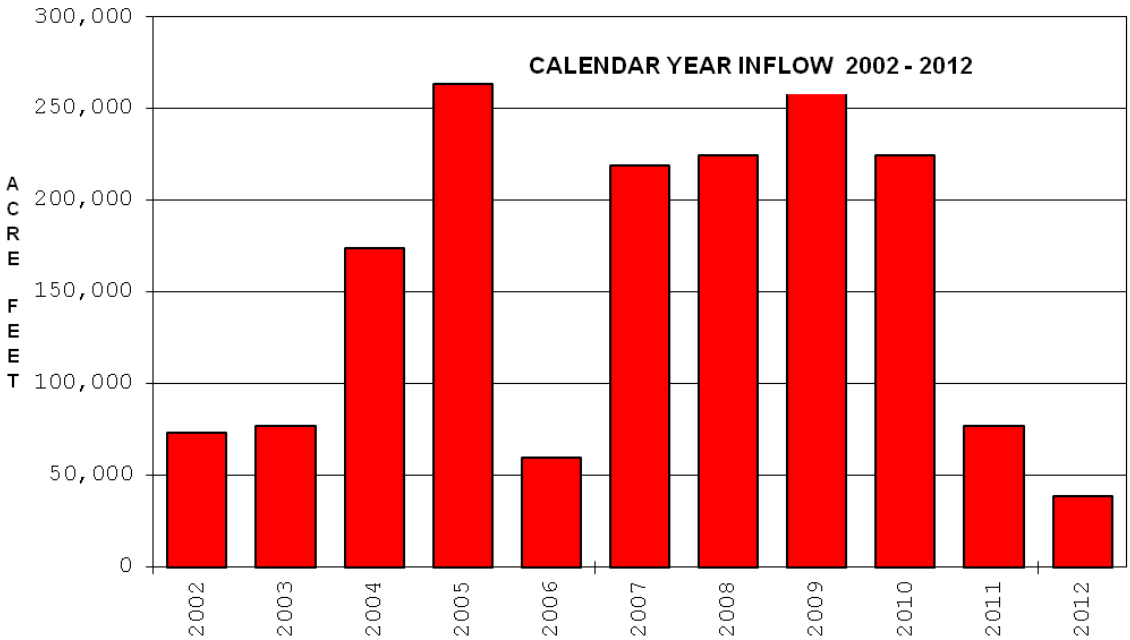
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,000 24 Mar 12	**50,085**	**100 Many days**	**20 Many days**

Minimum required release is 20 cfs. Releases reduced to 0 for maintenance and inspection periods.

MELVERN LAKE MONTHLY INFLOW

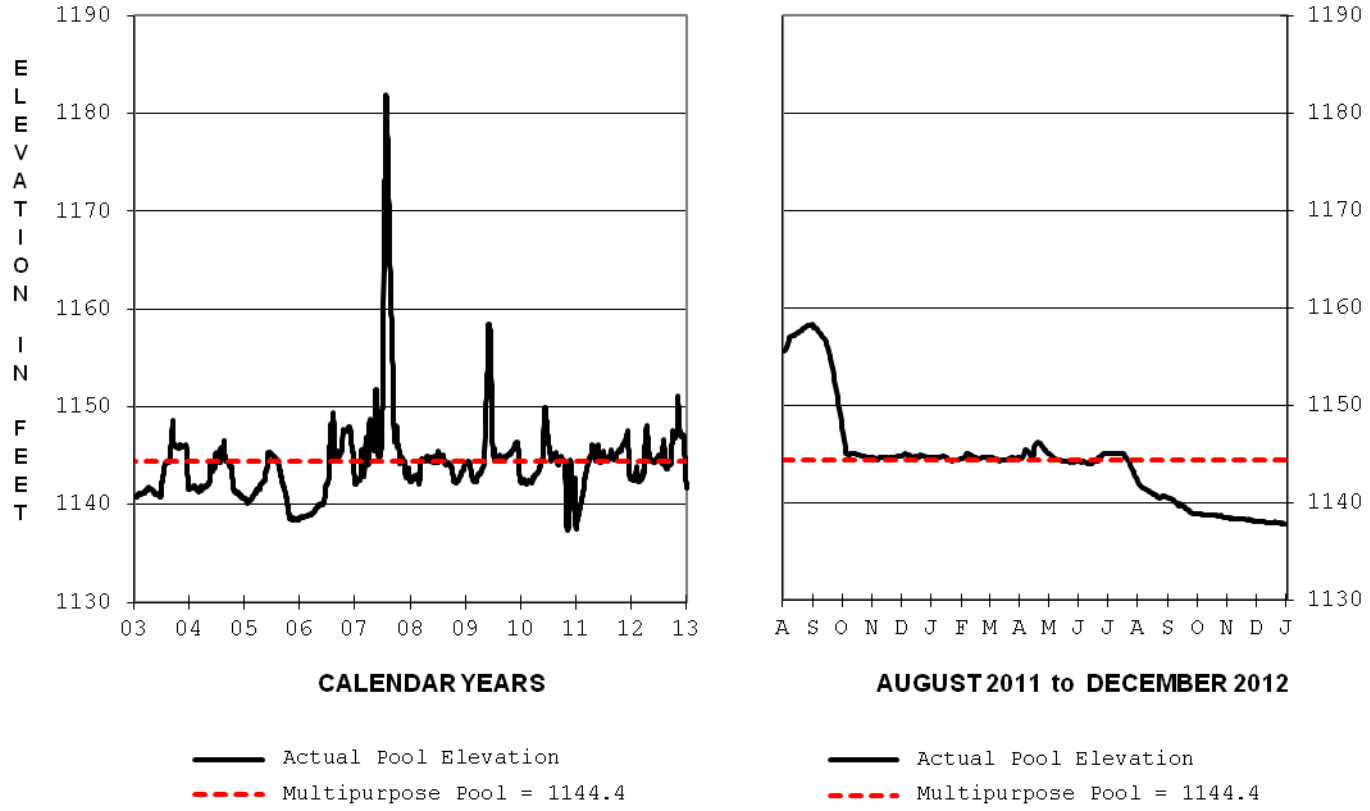


MELVERN LAKE ANNUAL INFLOW



MILFORD LAKE
2011 - 2012 REGULATION

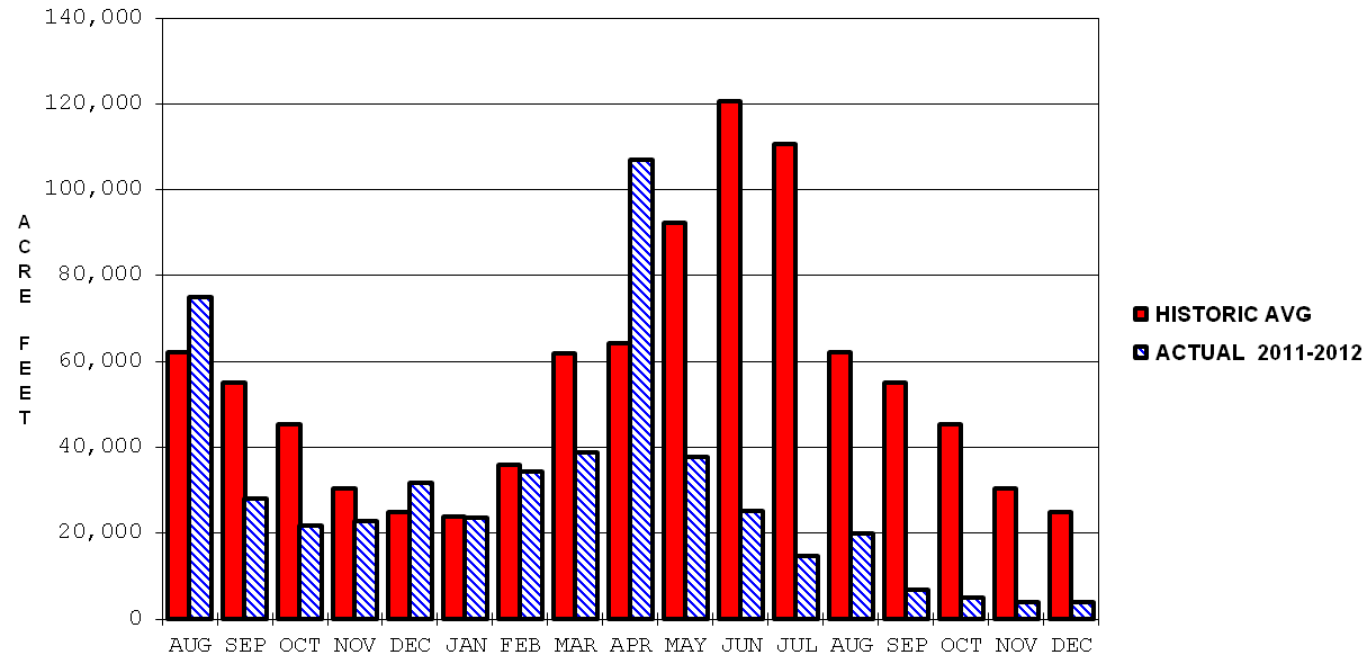
A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



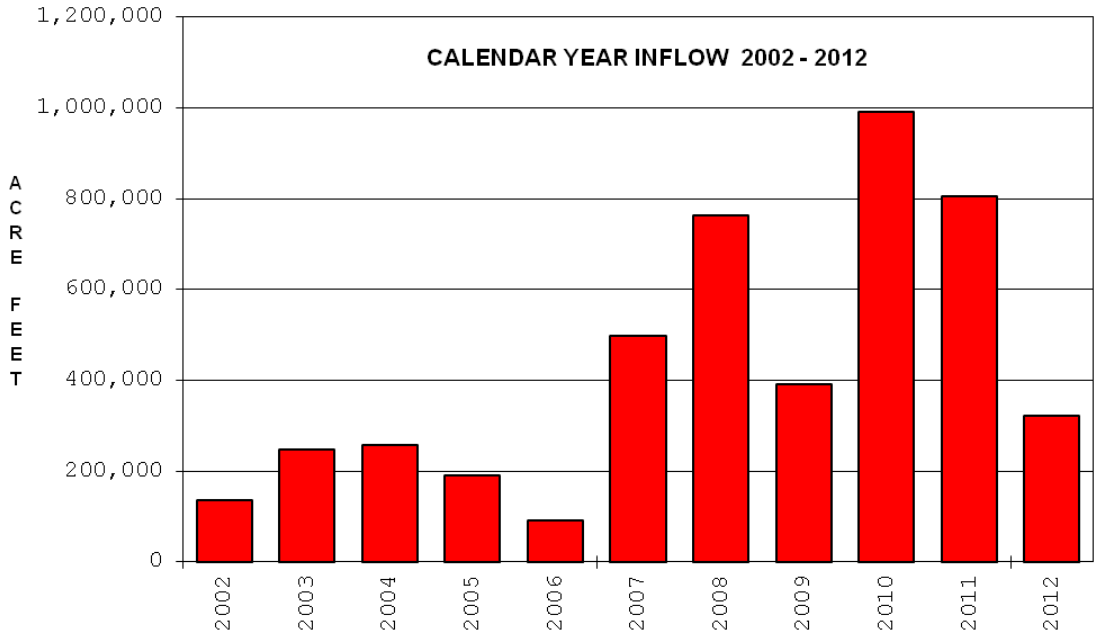
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1155.62 1 Aug 11	**1137.82 31 Dec 12**	**1158.30 31 Aug 11**	**1137.8 30 Dec 12**	**1181.94 25 Jul 93**	**1136.89 12-13 Jan 03**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
6,000 16 Apr 12	**500,558**	**6,000 21 Sep 11**	**25 Many days**
Minimum required release is 25 cfs.			

MILFORD LAKE MONTHLY INFLOW

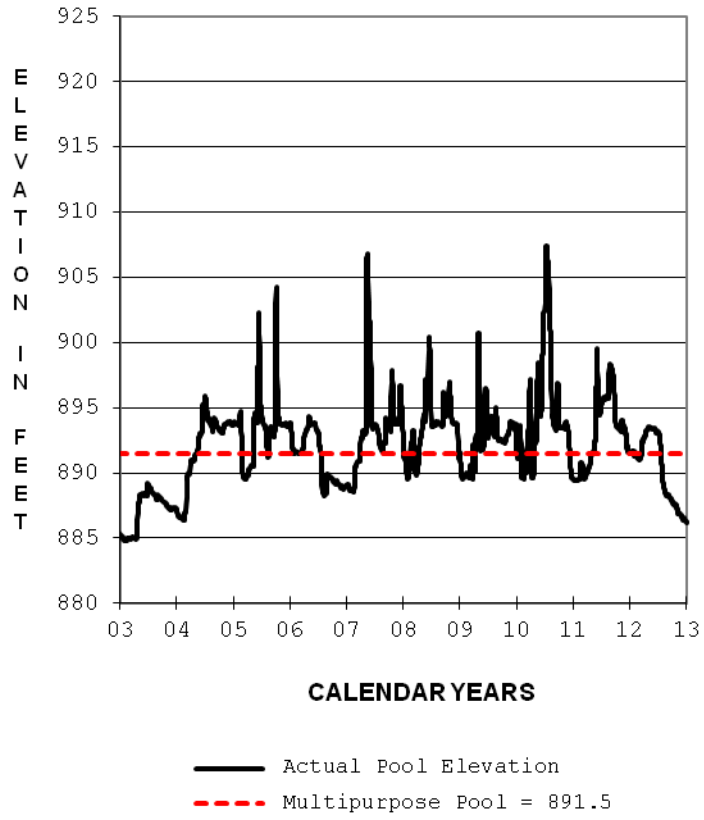


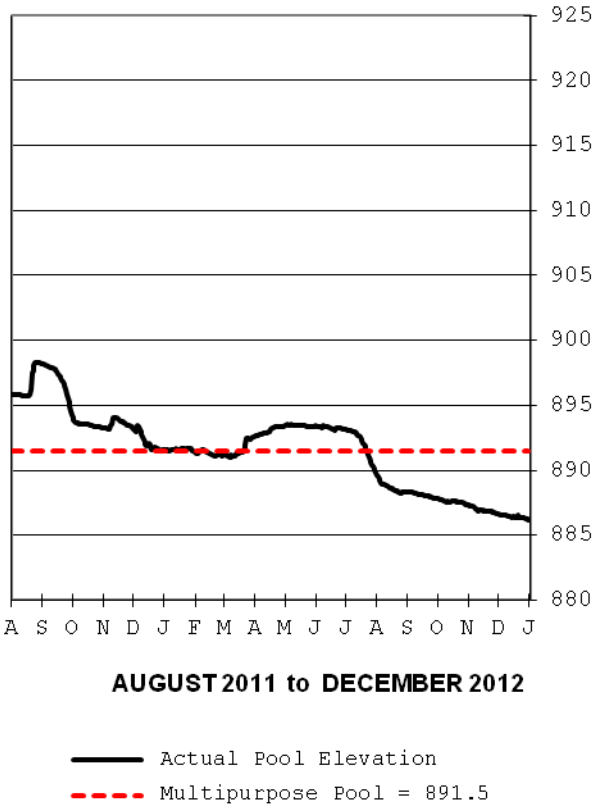
MILFORD LAKE ANNUAL INFLOW



PERRY LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



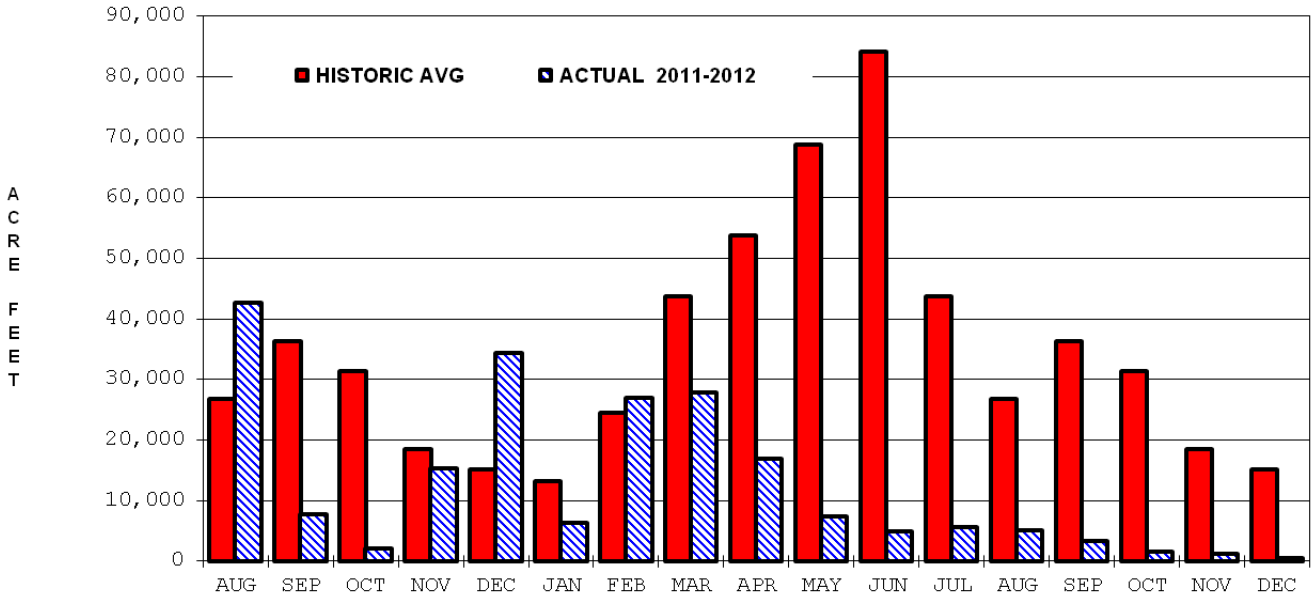


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
895.83 1 Aug 11	**886.19 31 Dec 12**	**894.08 1 Oct 11**	**886.19 12 Dec 12**	**920.85 25 Jul 93**	**884.77 30 Jan 03**

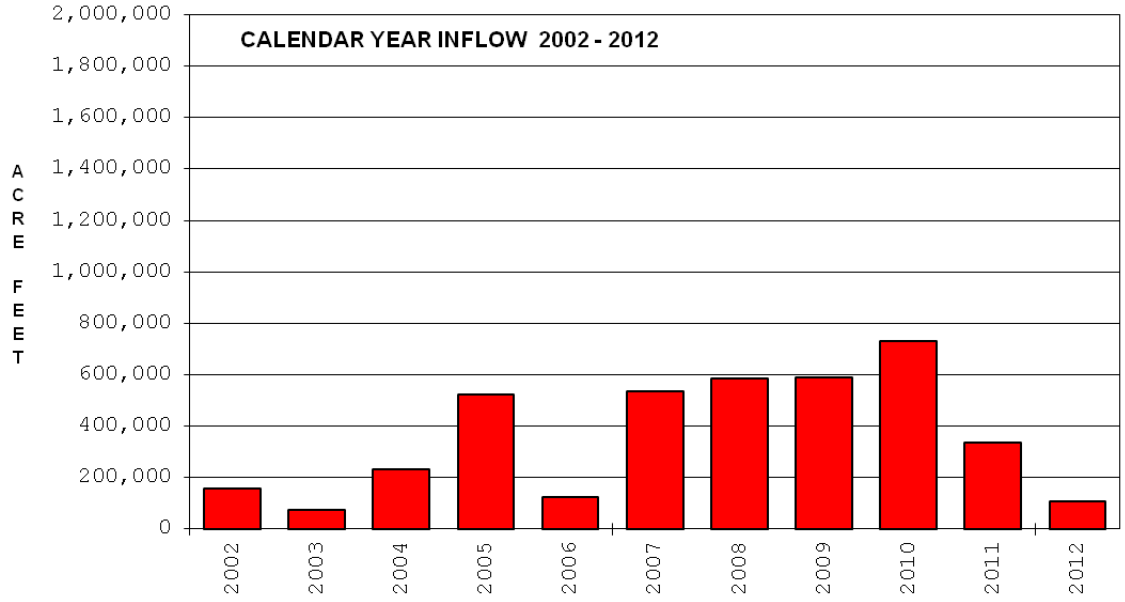
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
9,000 21 Aug 11	**210,016**	**2,000 25 Sep 11**	**0 9 May 12**

Minimum required release is 25 cfs. Releases reduced to 0 for maintenance and inspection periods.

PERRY LAKE MONTHLY INFLOW

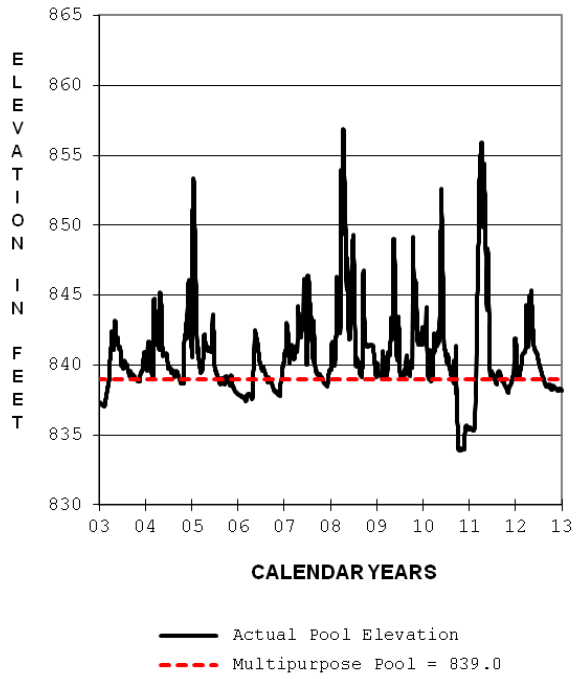


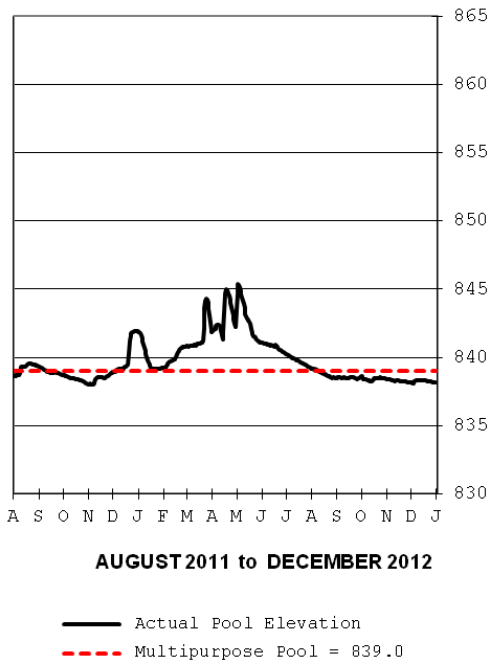
PERRY LAKE ANNUAL INFLOW



POMME DE TERRE LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



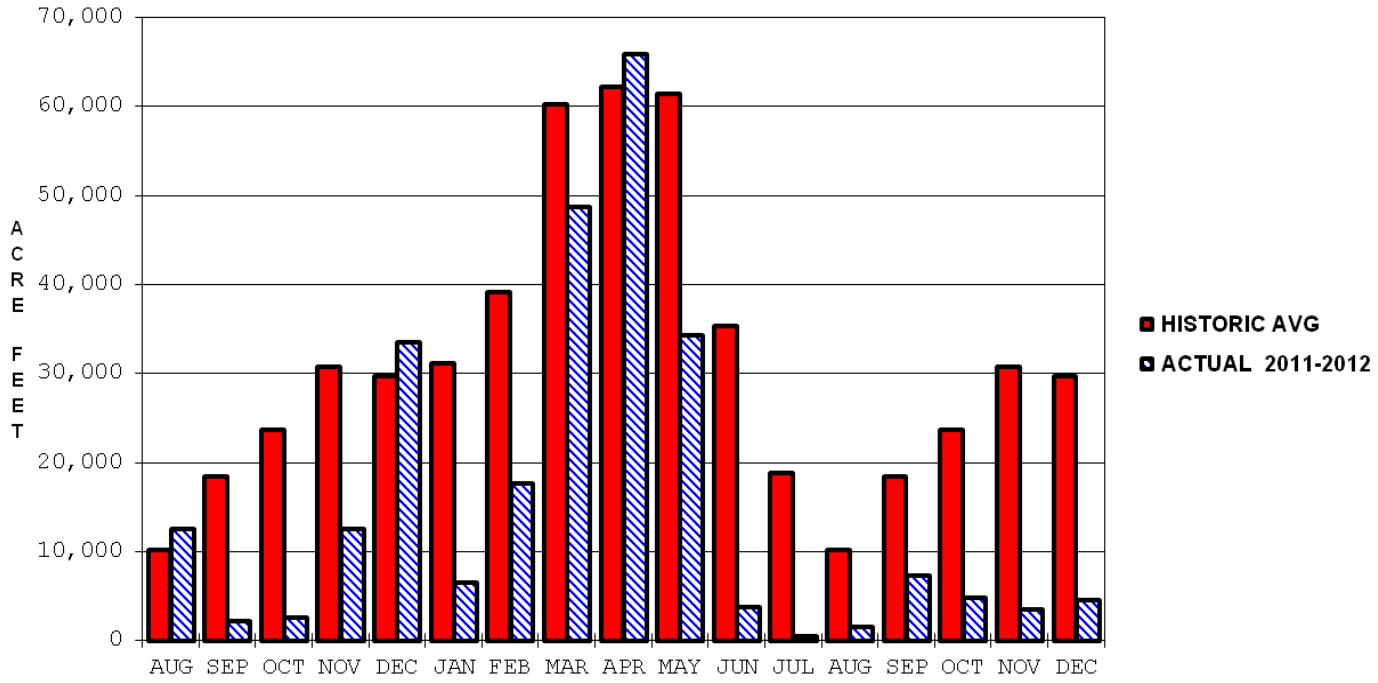


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
838.67 1 Aug 11	**838.14 31 Dec 12**	**845.38 2 May 12**	**838.12 3 Dec 12**	**864.58 27 Sep 93**	**833.89 1 Nov 10**

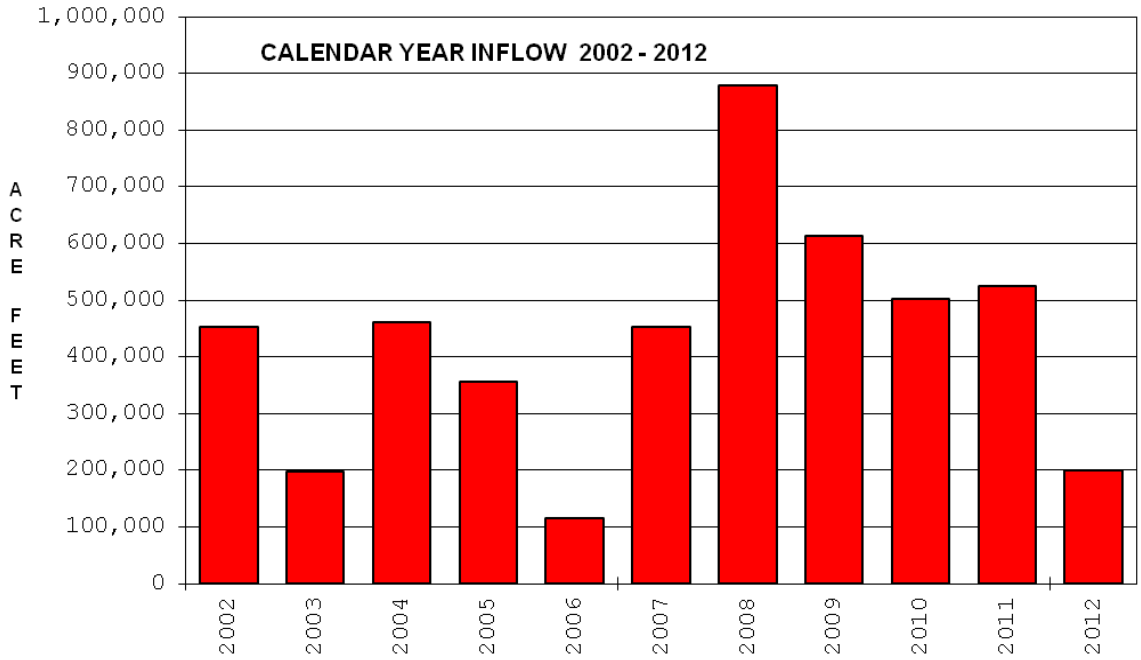
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
6,300 1 May 12	**261,729**	**2,800 28 Mar 12**	**0 4 Apr 12**

Minimum required release is 50 to 100 cfs, varying by season and pool level.

POMME DE TERRE LAKE MONTHLY INFLOW

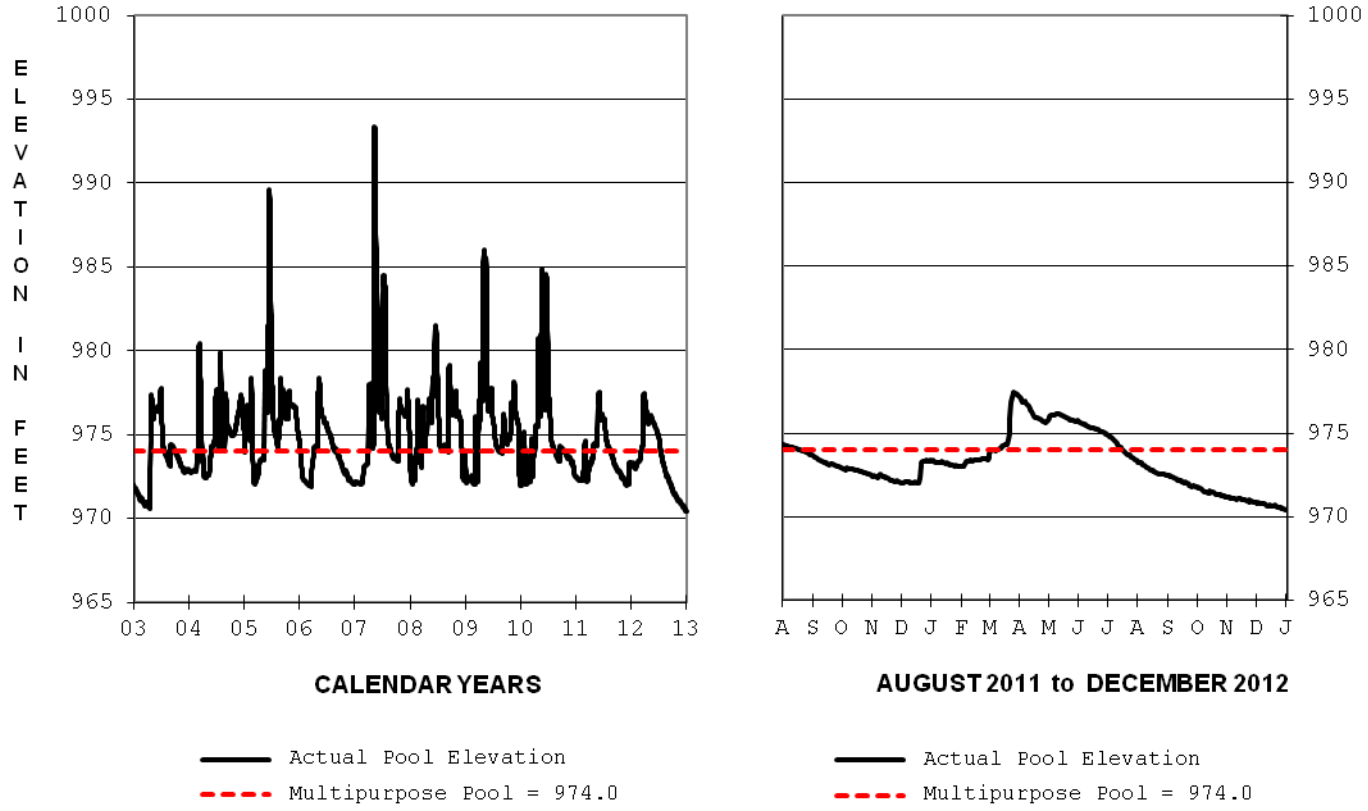


POMME DE TERRE LAKE ANNUAL INFLOW



POMONA LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW

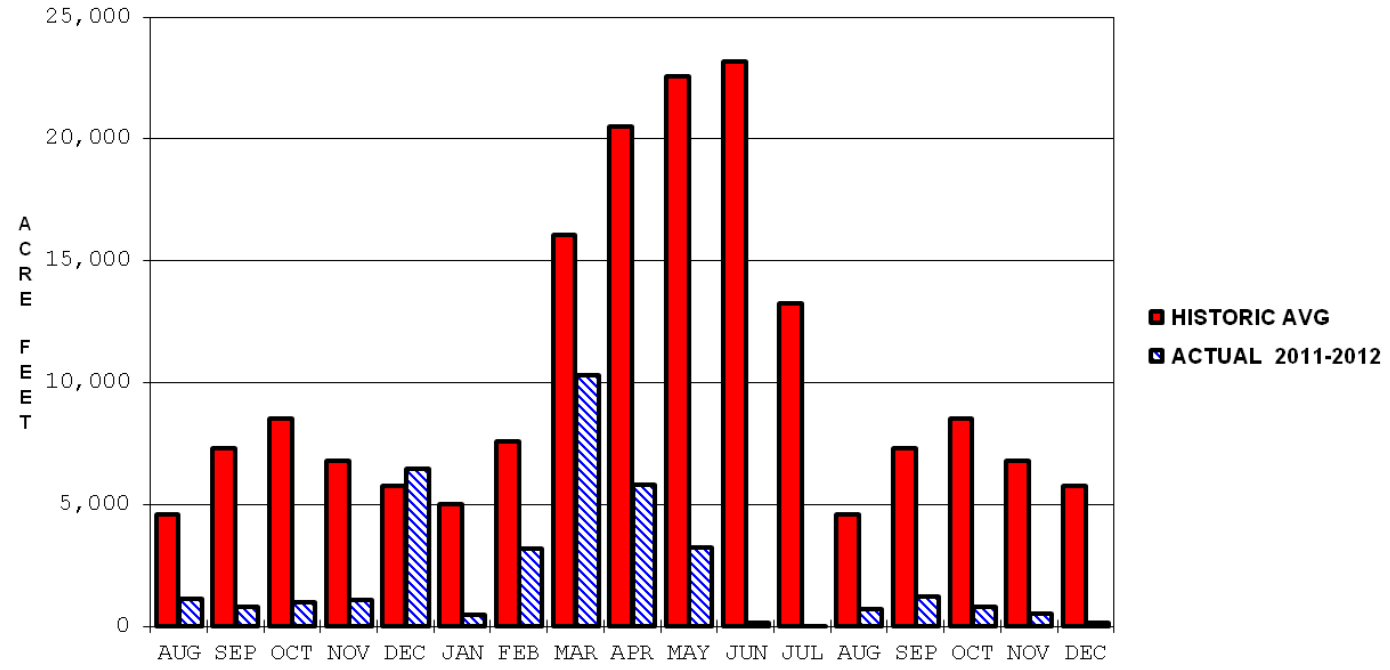


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
974.32 1 Aug 11	**970.43 31 Dec 12**	**977.44 26 Mar 12**	**970.43 31 Dec 12**	**998.40 12-13 Jun 95**	**969.62 30 Mar 67**

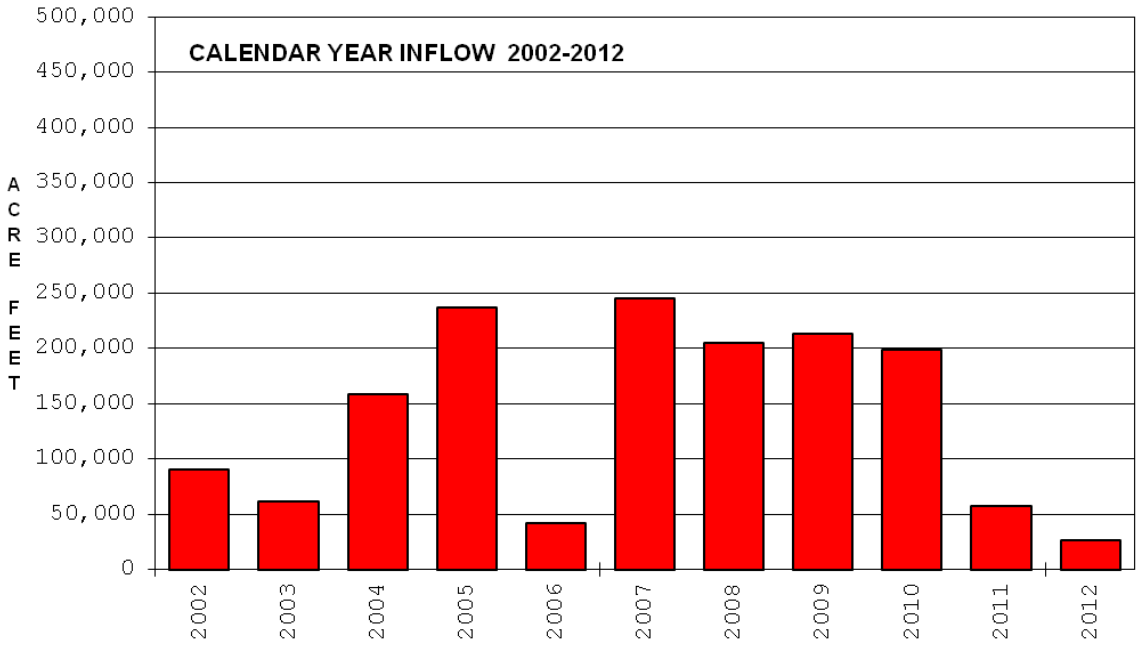
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,300 21 Dec 11	**36,989**	**300 Many days**	**0 22 Aug 12**

Minimum required release is 15 cfs.

POMONA LAKE MONTHLY INFLOW

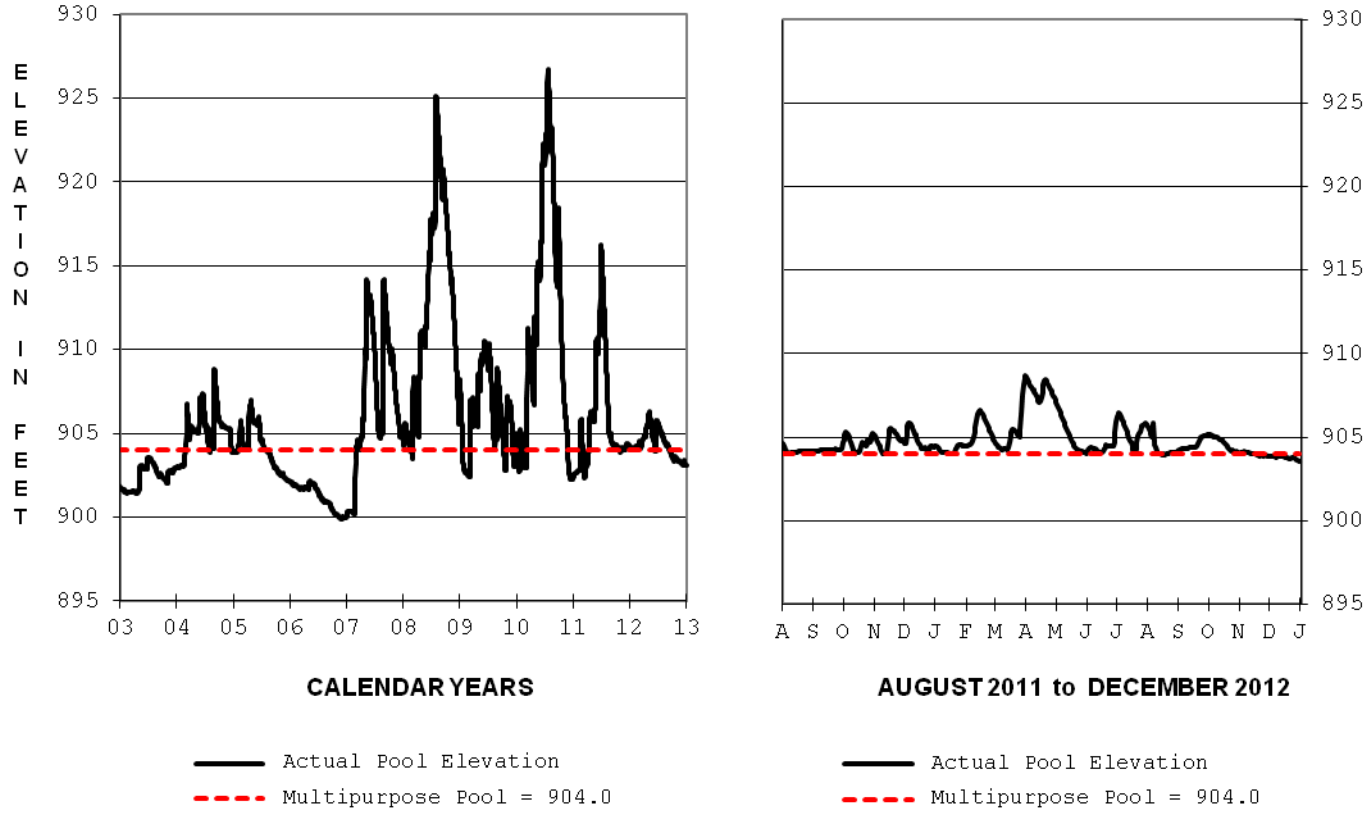


POMOMA LAKE ANNUAL INFLOW



RATHBUN LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

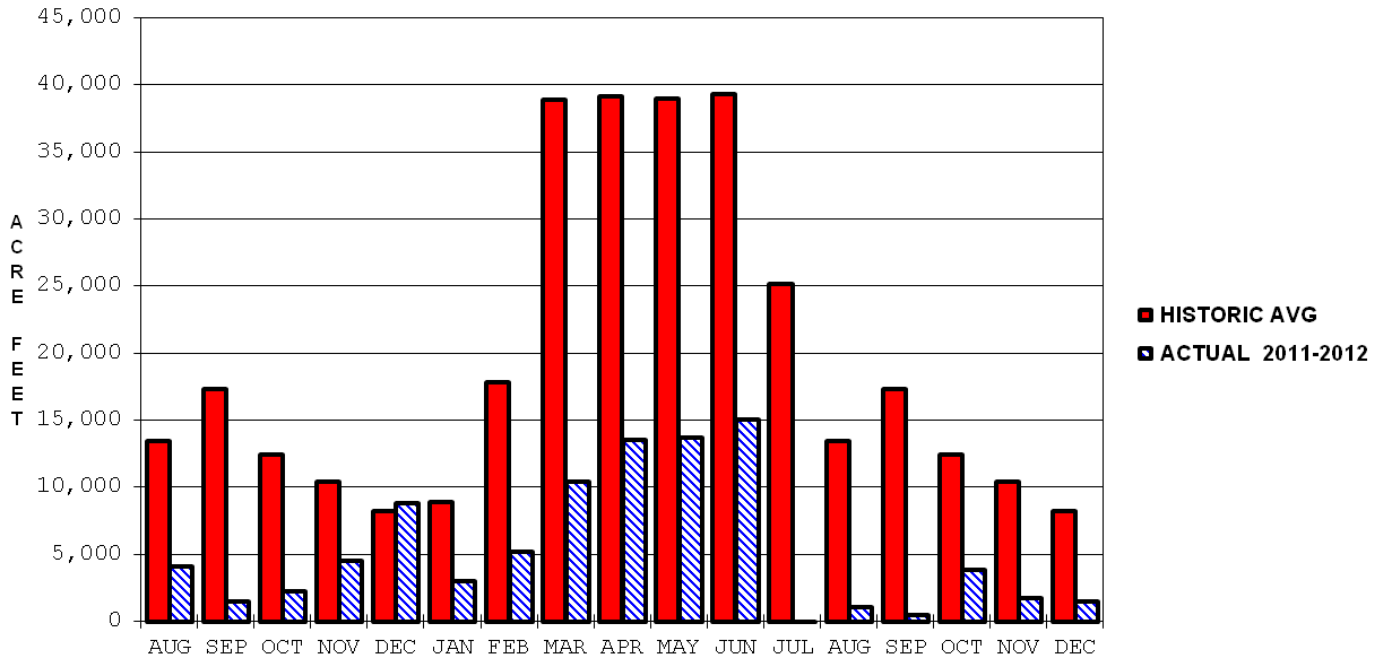


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
909.68 1 Aug 11	**903.07 31 Dec 12**	**906.29 8 May 12**	**903.07 31 Dec 12**	**927.16 28 Jul 93**	**898.38 26-27 Jan 95**

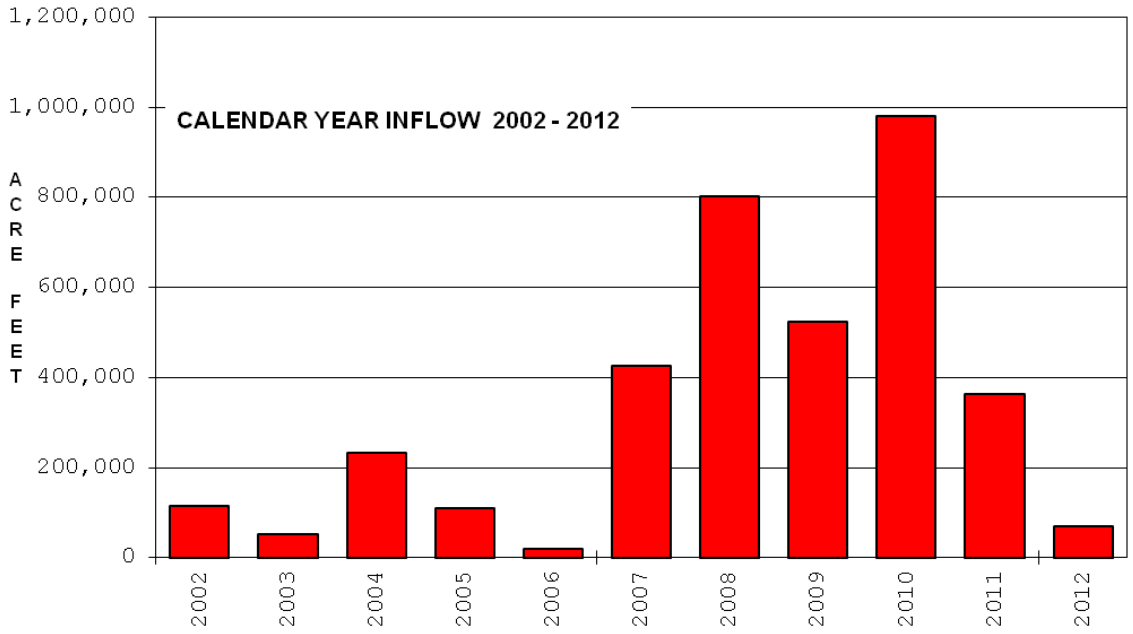
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,500 16 Apr 12	**91,701**	**1,506 1 Aug 11**	**25 Many days**

Outlets include a fish hatchery pipe and service gate. Minimum required release varies with downstream needs.

RATHBUN LAKE MONTHLY INFLOW

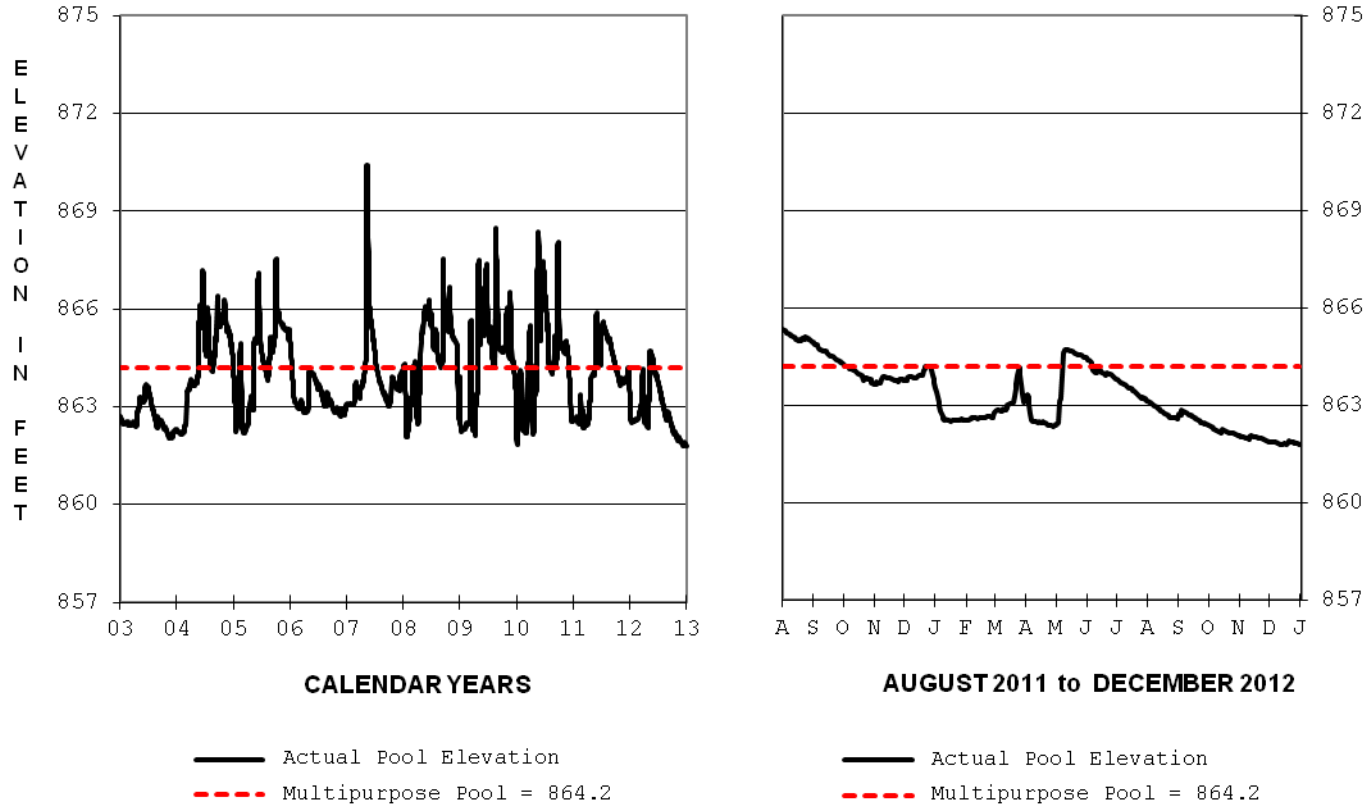


RATHBUN LAKE ANNUAL INFLOW



SMITHVILLE LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

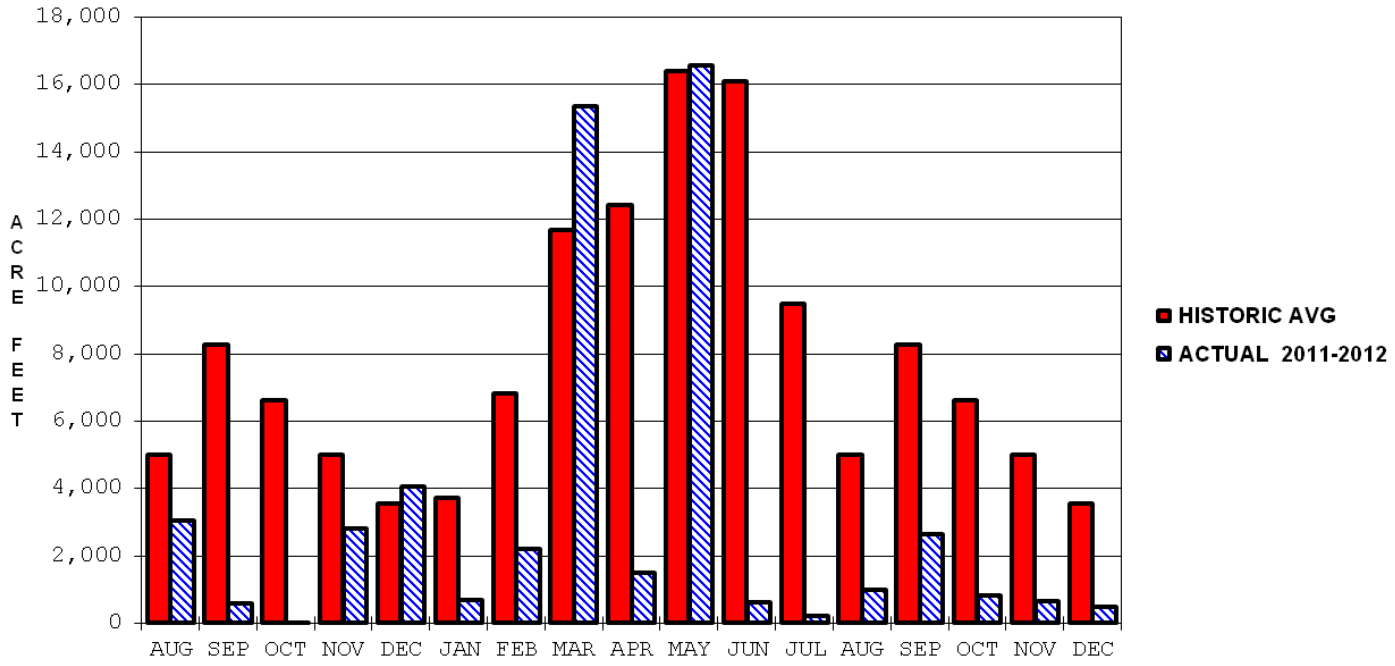


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
865.33 1 Aug 11	**861.8 31 Dec 12**	**864.72 12 May 12**	**861.79 14 Dec 12**	**874.31 27-28 Jul 93**	**858.86 19 Jan 93**

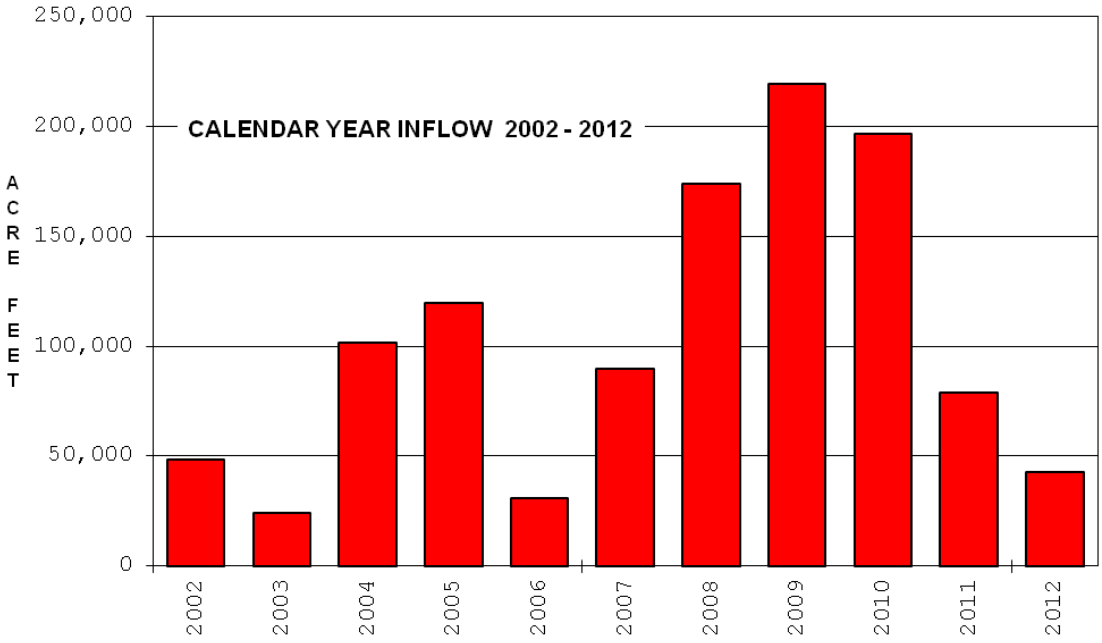
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,400 8 May 12	**53,436**	**1,200 27 Mar 12**	**0 19 Oct 11**

Minimum required release is 8 cfs. Releases cut to 0 during flooding and for maintenance and inspections.

SMITHVILLE LAKE MONTHLY INFLOW

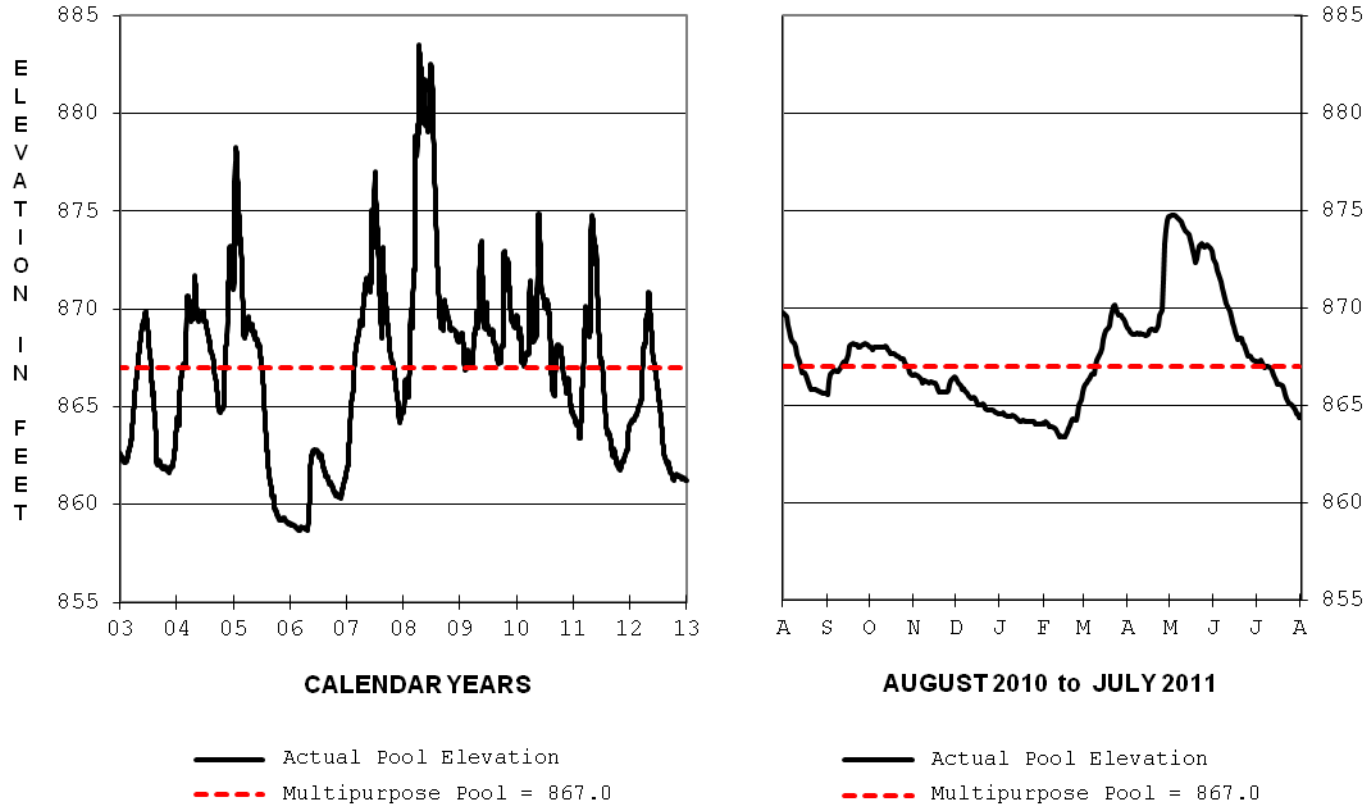


SMITHVILLE LAKE ANNUAL INFLOW



STOCKTON LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

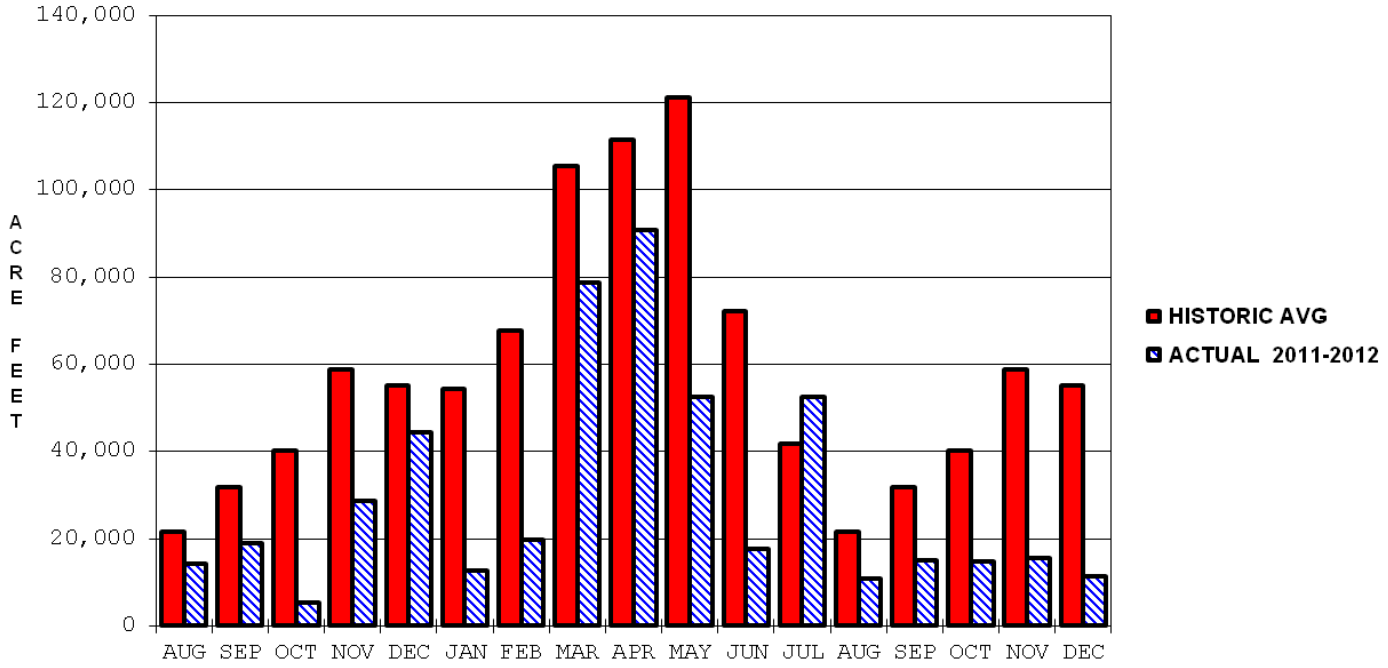


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
864.26 1 Aug 11	**861.22 31 Dec 12**	**870.85 4 May 12**	**861.21 29 Dec 12**	**885.94 28 Apr 73**	**851.86 2 Feb 77**

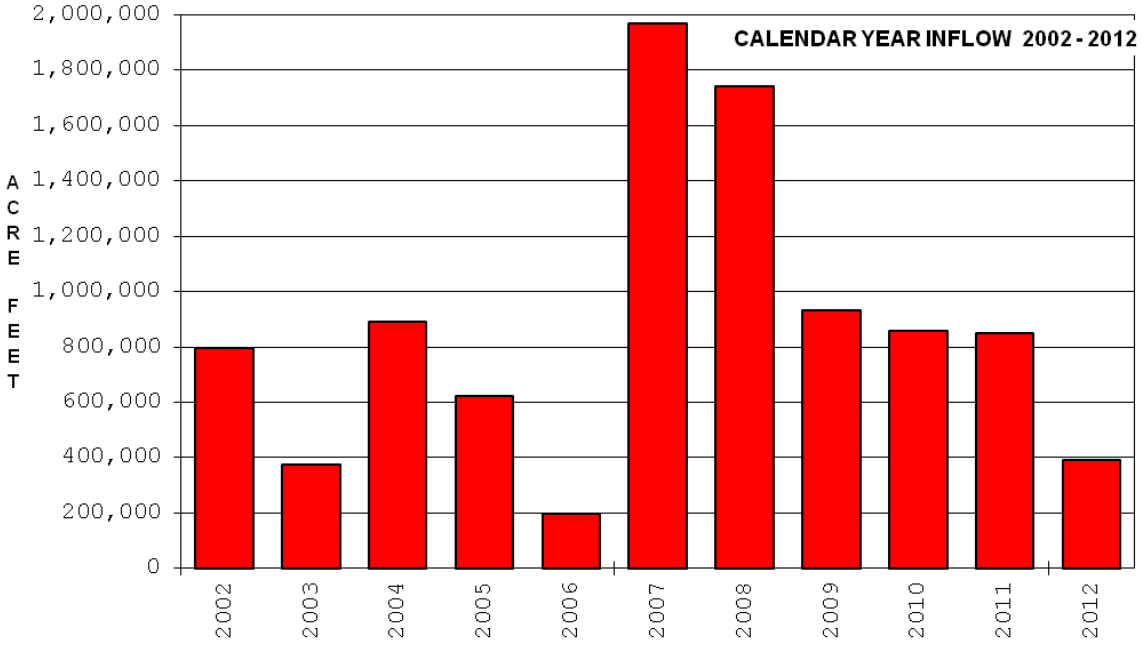
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
6,500 2 May 12	**450,971**	**3,462 9 May 12**	**40 Many Days**

Listed outflows include turbine releases and spill to the river. Minimum required release is 40 cfs.

STOCKTON LAKE MONTHLY INFLOW

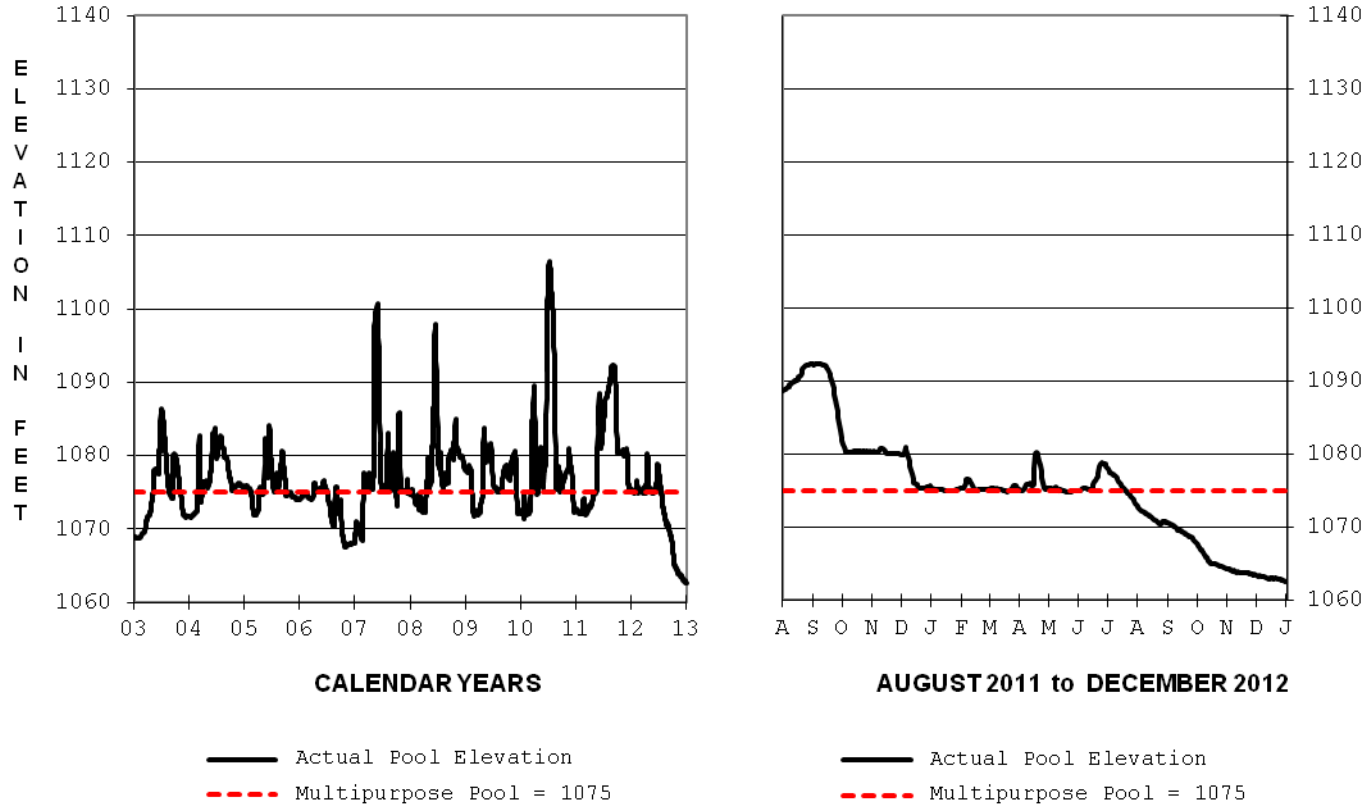


STOCKTON LAKE ANNUAL INFLOW



TUTTLE CREEK LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

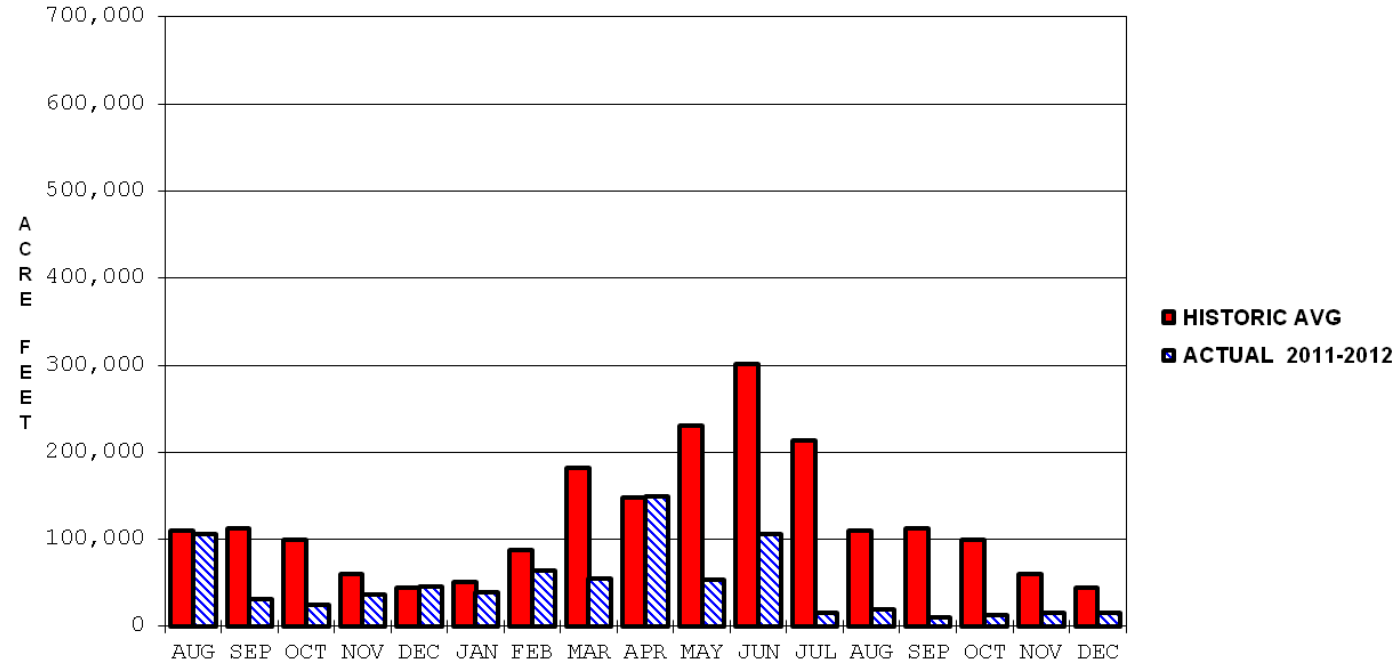


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1088.73 1 Aug 11	**1062.58 31 Dec 12**	**1081.76 1 Oct 11**	**1062.57 30 Dec 12**	**1137.77 22 Jul 93**	**1060.82 4 Jan 67**

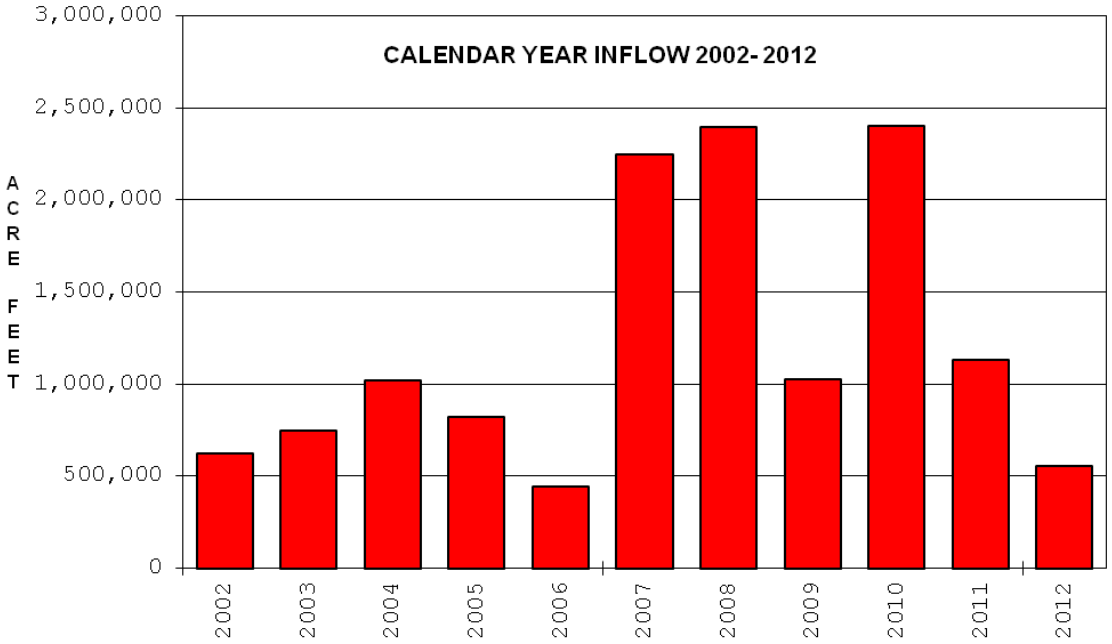
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
14,000 16 Apr 12	**800,366**	**8,000 23 Sep 11**	**200 Many days**

Minimum required release is 50 to 100 cfs. Releases may be cut to 0 for maintenance and inspection periods.

TUTTLE CREEK LAKE MONTHLY INFLOW

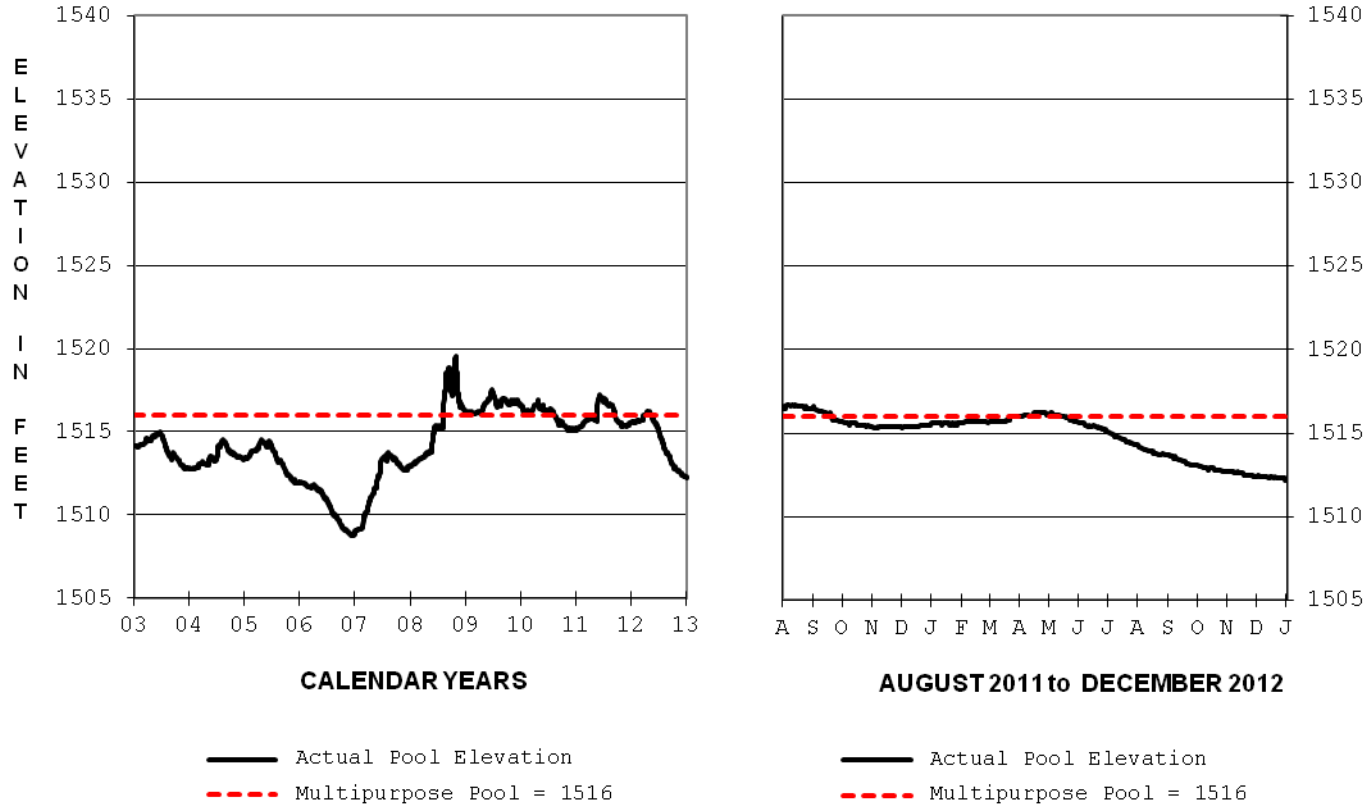


TUTTLE CREEK LAKE ANNUAL INFLOW



WILSON LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

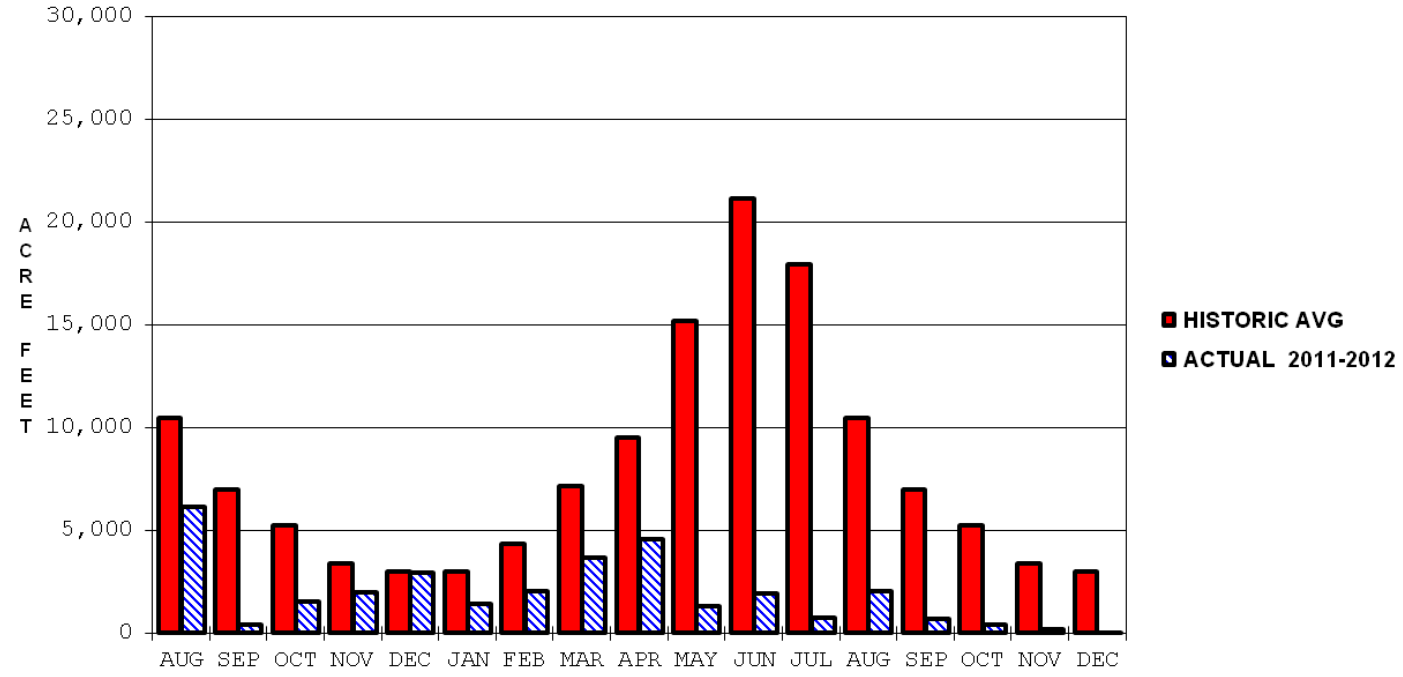


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1516.55 1 Aug 11	**1512.24 31 Dec 12**	**1516.20 16 Apr 12**	**1512.24 31 Dec 12**	**1548.27 13 Aug 93**	**1508.73 19 Dec 06**

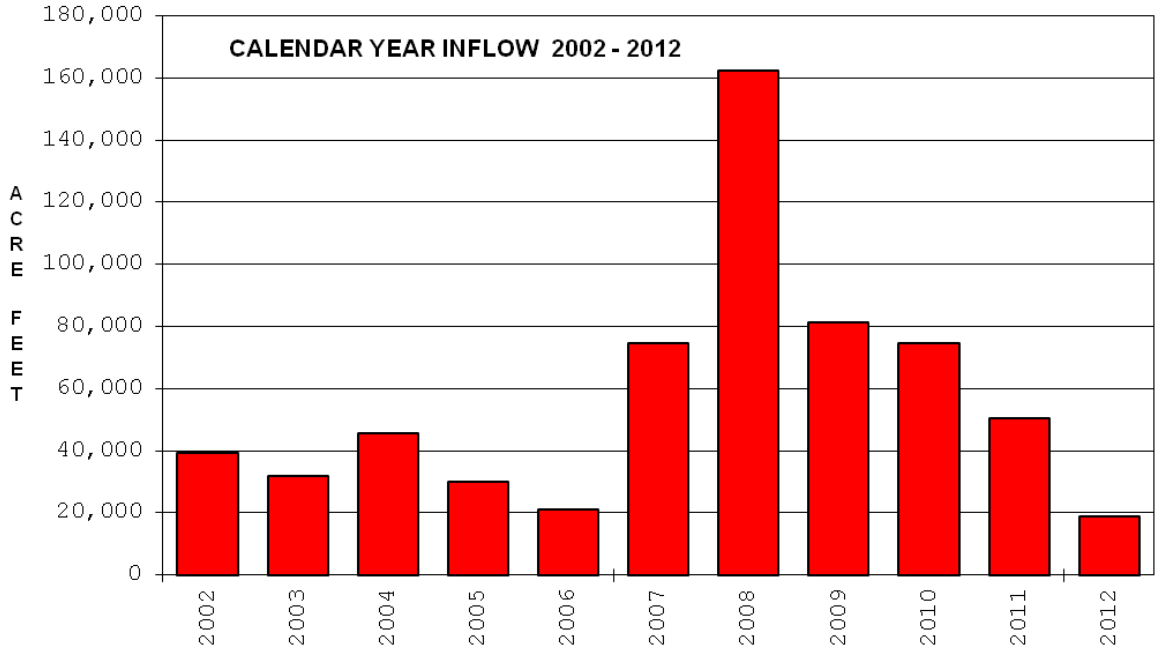
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
775 15 Apr 12	**31,693**	**15 Many days**	**0 22 Aug 12**

Minimum required release of 5-15 cfs varies seasonally. Releases cut to 0 for maintenance and inspections.

WILSON LAKE MONTHLY INFLOW



WILSON LAKE ANNUAL INFLOW



APPENDIX B
BUREAU OF RECLAMATION PROJECTS

BONNY RESERVOIR

CEDAR BLUFF RESERVOIR

ENDERS RESERVOIR

HARRY STRUNK LAKE
(Medicine Creek Dam)

HUGH BUTLER LAKE
(Red Willow Dam)

KEITH SEBELIUS LAKE
(Norton Dam)

KIRWIN RESERVOIR

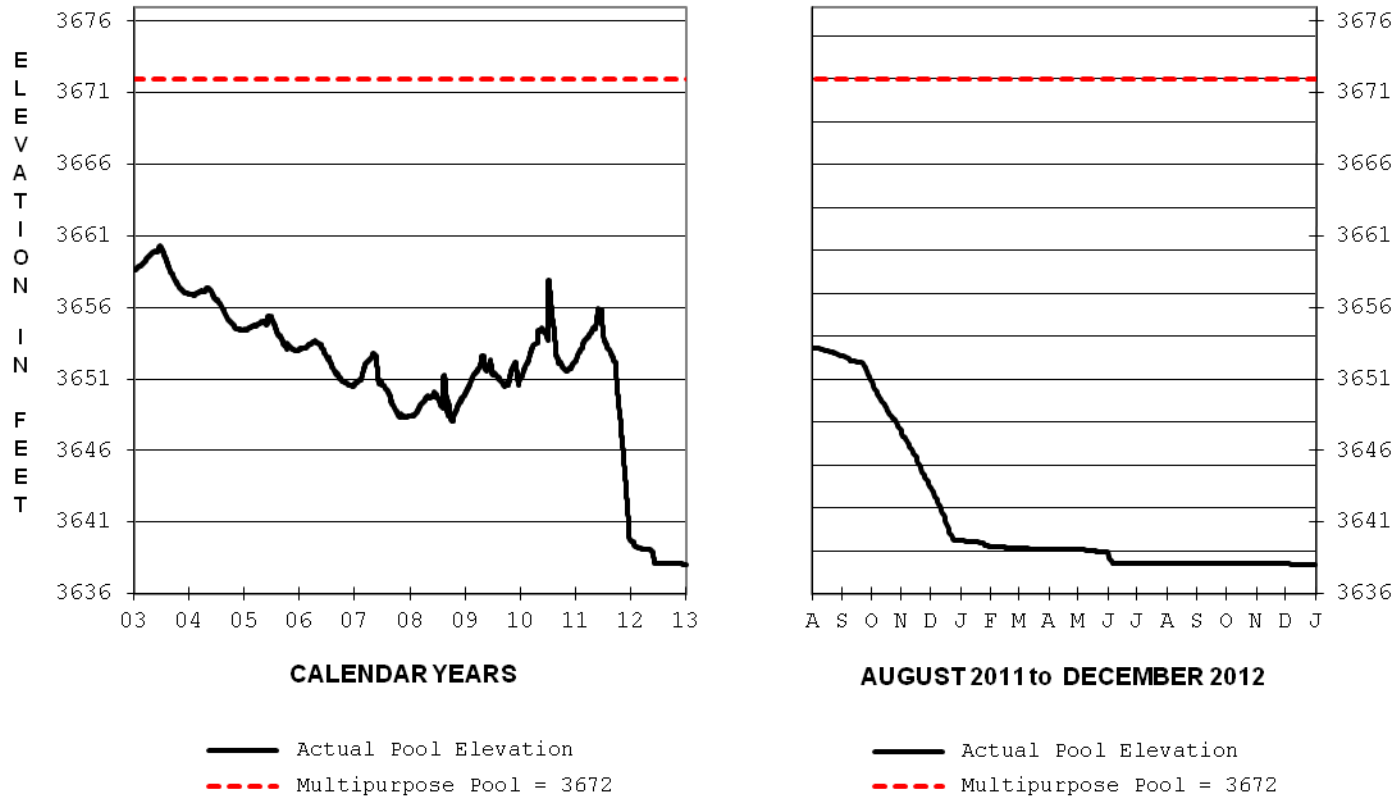
LOVEWELL RESERVOIR

SWANSON LAKE
(Trenton Dam)

WACONDA LAKE
(Glen Elder Dam)

WEBSTER RESERVOIR

BONNY RESERVOIR
2011 - 2012 REGULATION



A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

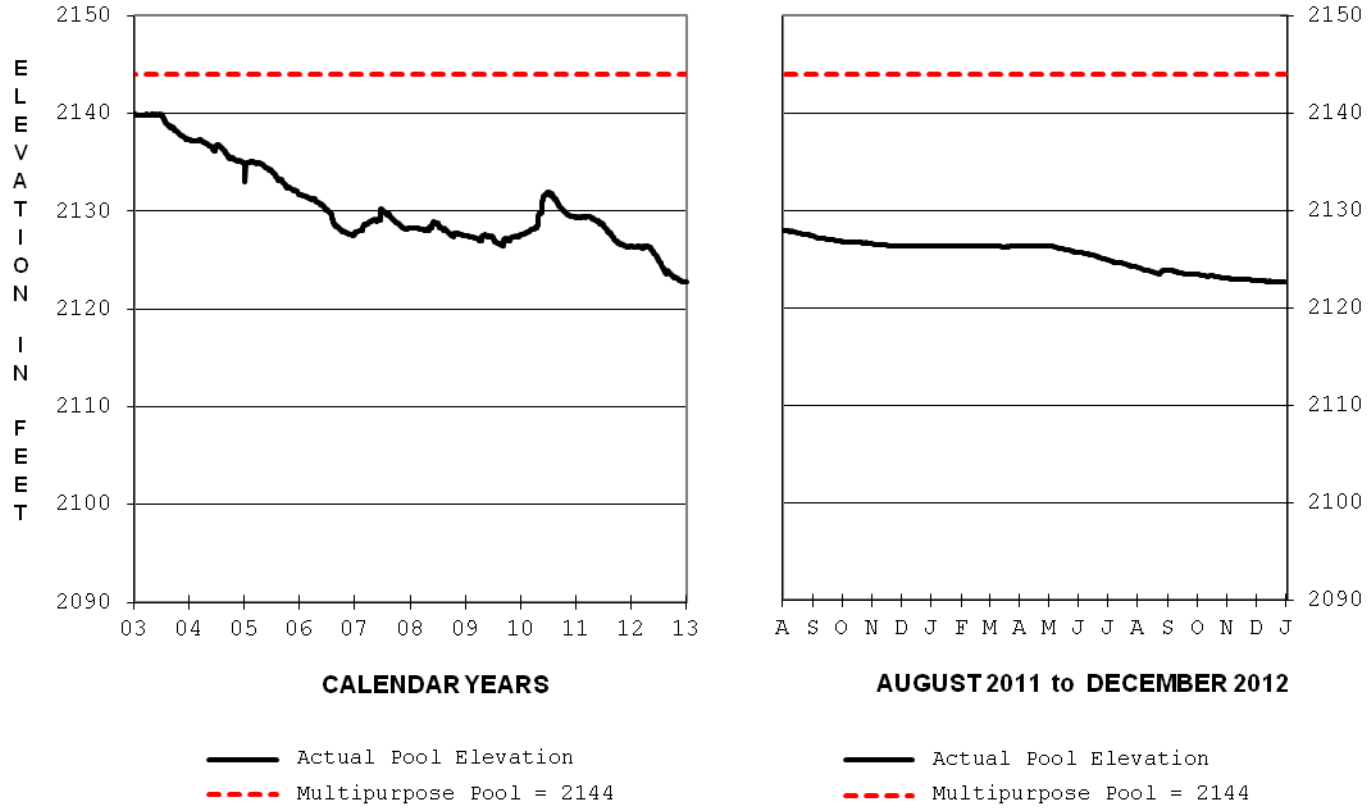
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
3638.09 1 Aug 11	**3638.00 31 Dec 12**	**3638.09 many**	**3638.00 31 Dec 12**	**3678.10 17 May 57**	**3638.00 31 Dec 12**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
90 5 Aug 11	**6,457**	**63 25 Sep 11**	**1 Many days**

Maximum daily outflow is river release only. Minimum required release is 5 cfs.

CEDAR BLUFF RESERVOIR
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



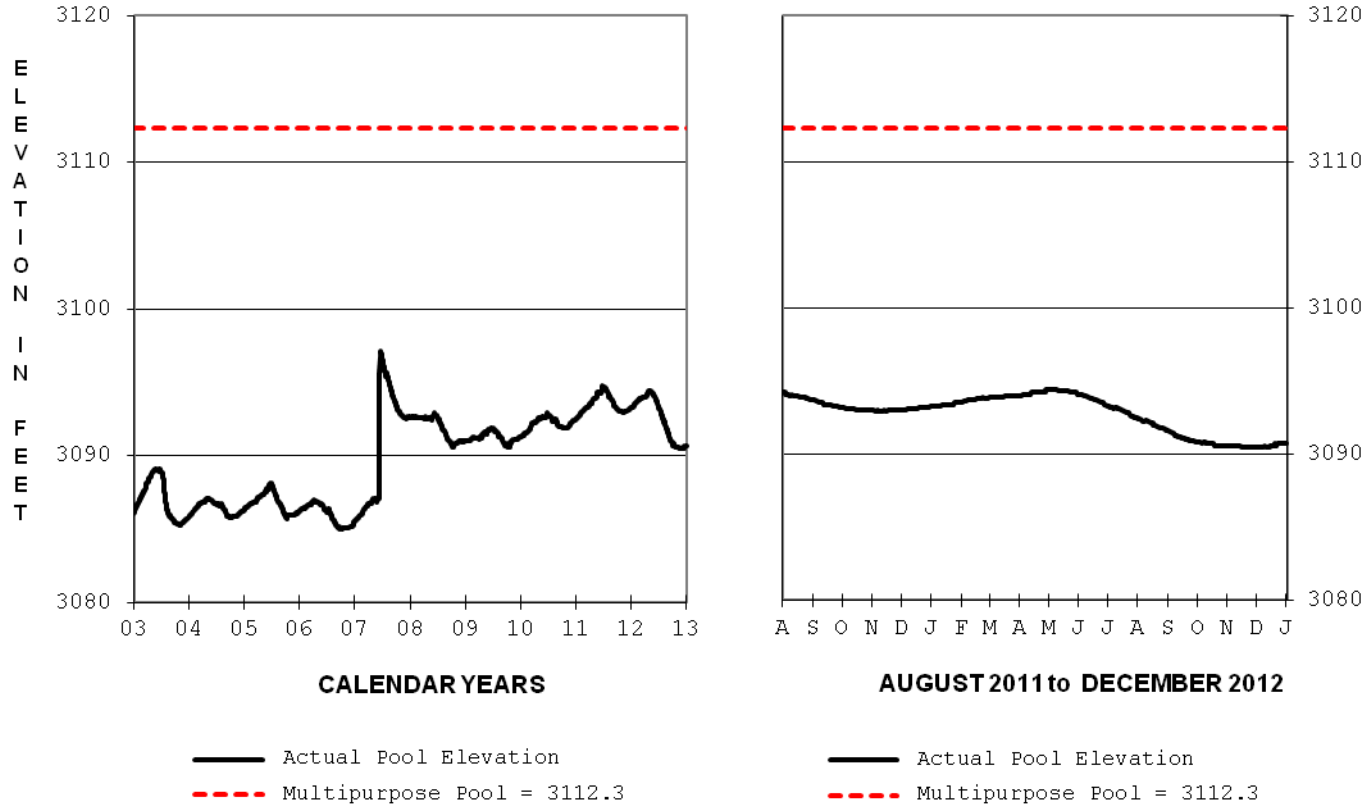
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2127.91 1 Aug 11	**2122.67 31 Dec 12**	**2126.41 17 Apr 12**	**2122.67 31 Dec 12**	**2154.90, 2 Jul 51 4-5 Jul 57**	**2091.78 9-19 Nov 92**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
320 26 Aug 12	**12,670**	**0 All Year**	**0 All Year**

No minimum required release. Minor releases to the fish hatchery are not reported on a daily basis.

ENDERS RESERVOIR
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

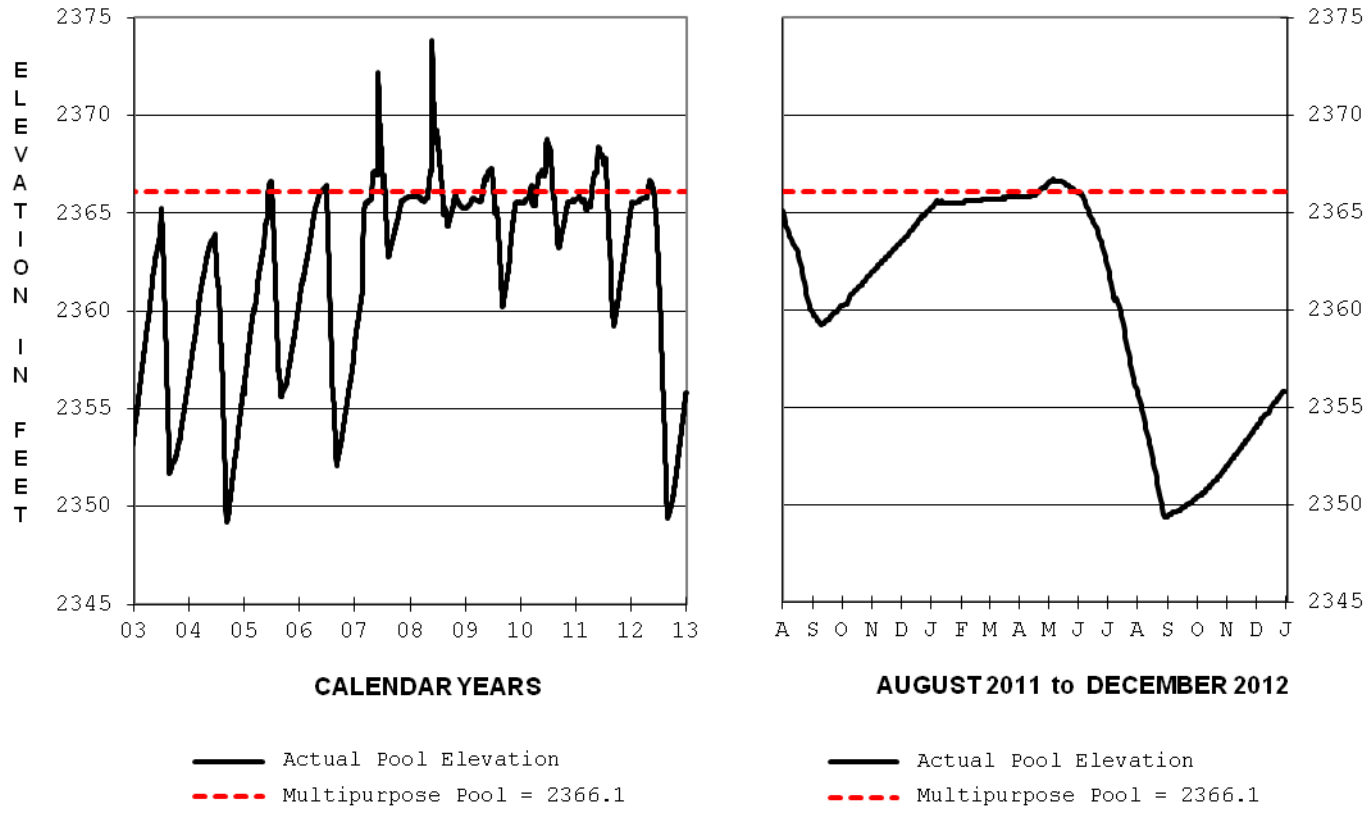


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
3094.22 1 Aug 11	**3090.70 31 Dec 12**	**3094.42 1 May 12**	**3090.52 11 Dec 12**	**3118.20 25 Mar 60**	**3080.67 28 Aug 78**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
80 28 Apr 12	**7,302**	**5 many**	**4 many**
No minimum required release. The outflow is mostly seepage.			

HARRY STRUNK LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



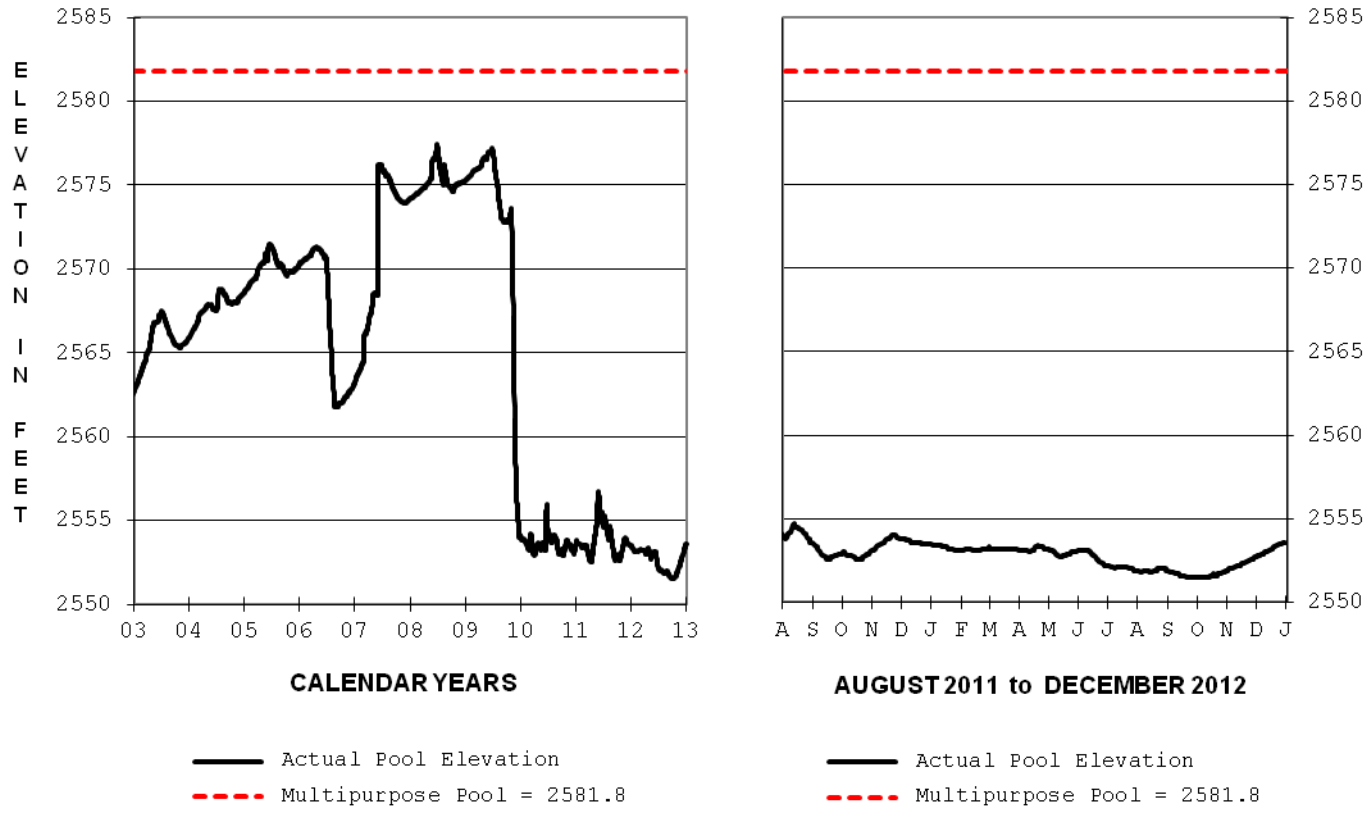
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2365.05 1 Aug 11	**2355.84 31 Dec 12**	**2366.65 5 May 12**	**2349.37 28 Aug 12**	**2374.10 23 Mar 60**	**2340.42 8 Sep 78**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
220 9 Mar 12	**45,877**	**280 3 Aug 11**	**1 Many Days**

Max daily outflow occurred as part of normal irrigation releases. All releases to the river. No min required release.

HUGH BUTLER LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



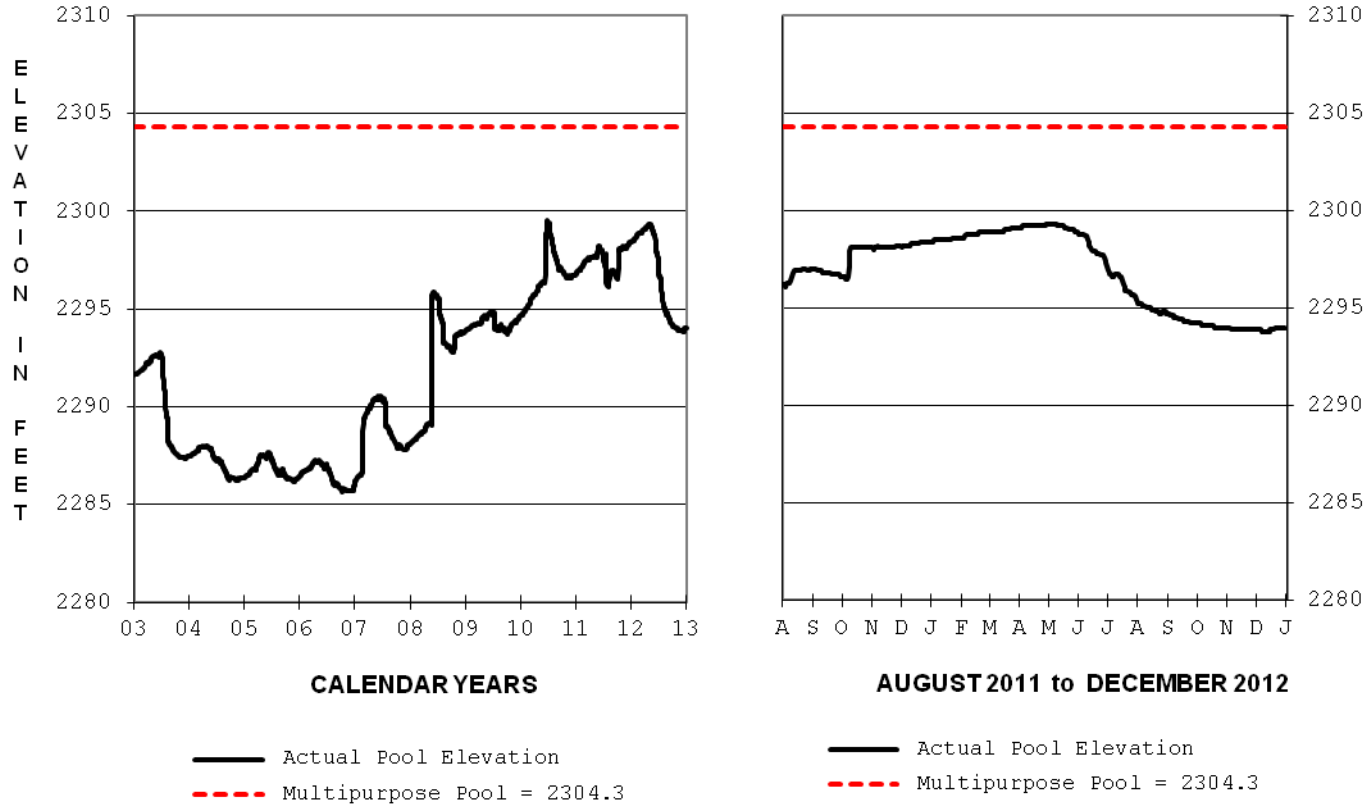
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2553.98 1 Aug 11	**2553.59 31 Dec 12**	**2553.59 31 Dec 12**	**2551.49 7 Oct 12**	**2584.11 16 Jul 67**	**2552.5 7 Apr 11**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
150 18 Oct 11	**17.012**	**44 13 Aug 11**	**2 Many Days**

No minimum required release. The outflow is mostly seepage.

KEITH SEBELIUS LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD E XPANDED FOR READING EASE.



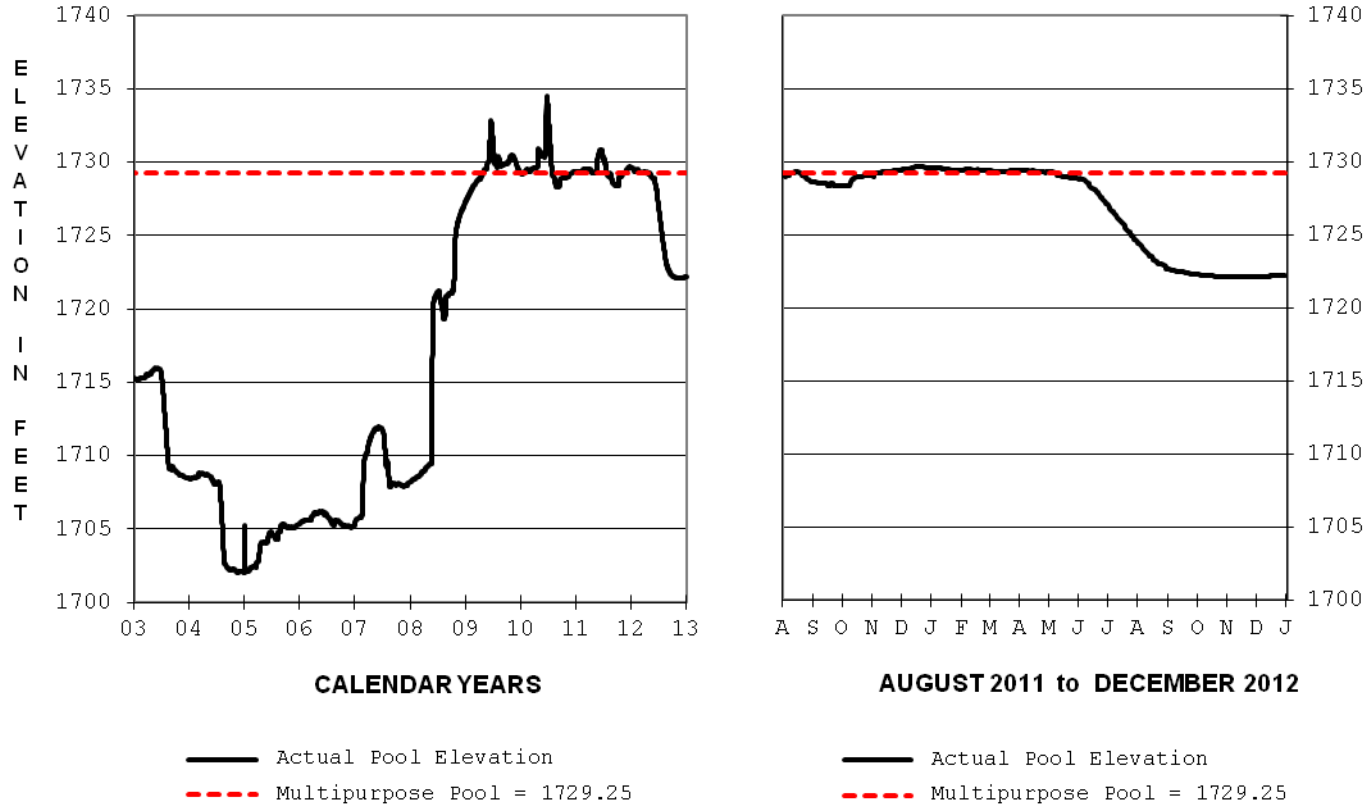
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2296.19 1 Aug 11	**2293.97 31 Dec 12**	**2299.32 2 May 12**	**2293.82 13 Dec 12**	**2306.47 15 Feb to 4 Mar 97**	**2275.82 1 Feb 82**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
680 9 Oct 11	**13,022**	**117 30 Jun 12**	**1 Many days**

No minimum required release. The normal outflow is mostly seepage.
Historic Minimum Pool Elevation of 2275.82 occurred on many days 28-29 Nov 81 and 20 Jan to 1 Feb 82.

KIRWIN RESERVOIR
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



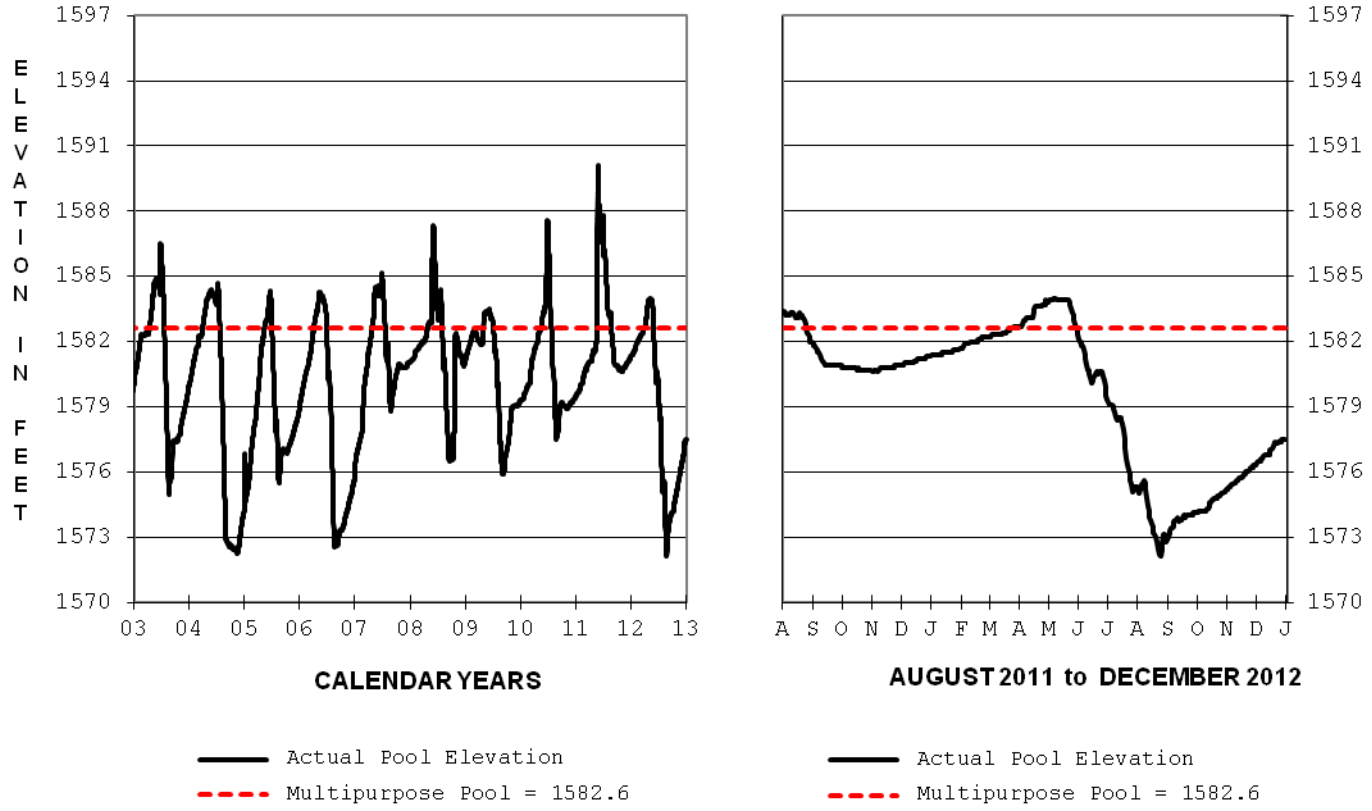
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1729.12 1 Aug 11	**1722.21 31 Dec 12**	**1729.62 30 Dec 11**	**1722.05 24 Nov 12**	**1737.07 2 Jun 95**	**1695.45 11 Feb 81**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
425 10 Oct 11	**40,026**	**164 20 Jul 12**	**0 Many Days**

Max daily outflow is river release only. Max release to canal was 150 cfs on 7 Aug 04. No min required release.

LOVEWELL RESERVOIR
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



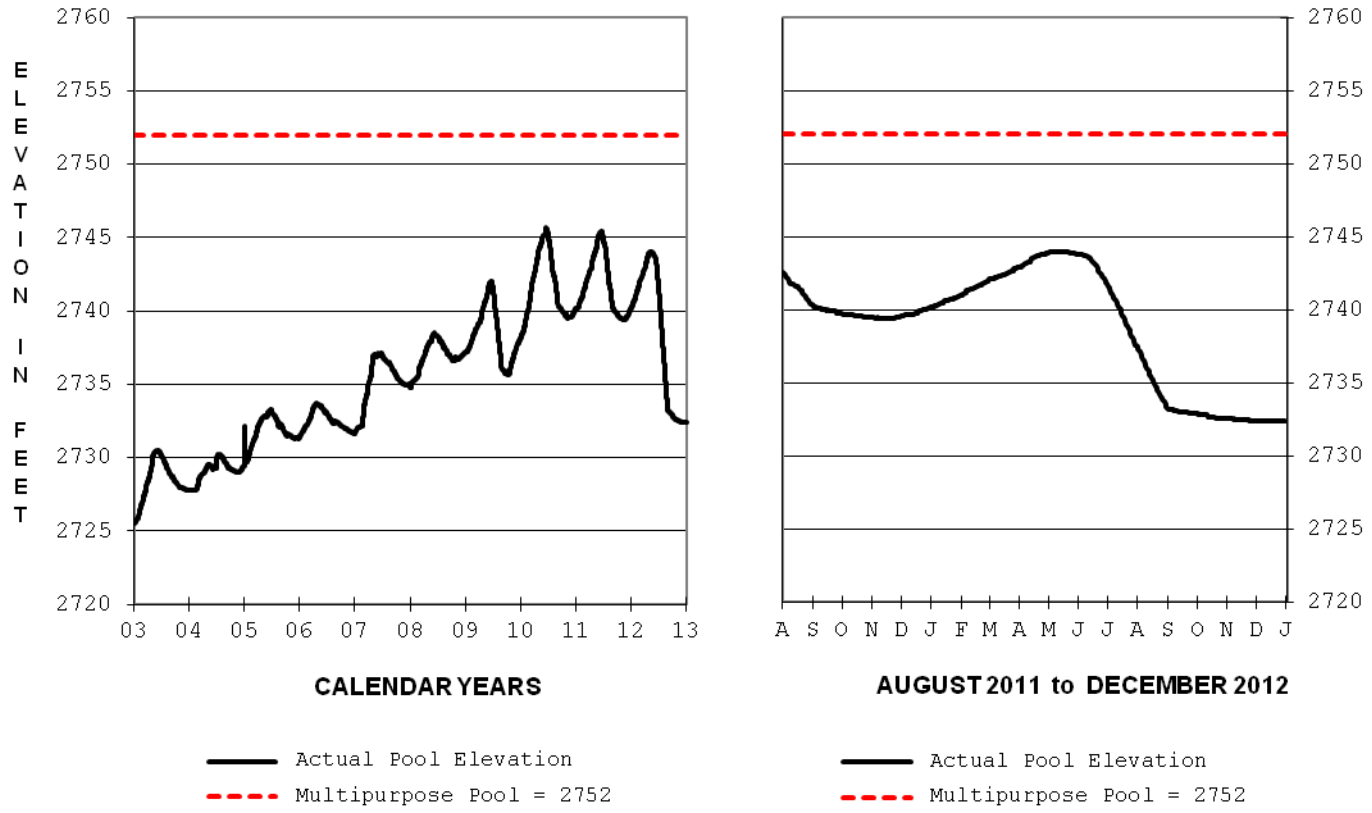
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1583.44 1 Aug 11	**1577.53 31 Dec 12**	**1583.96 6 May 12**	**1572.10 24 Aug 12**	**1595.34 22 Jul 93**	**1570.20 22 Aug 91**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
550 15 Apr 12	**28,977**	**519 19 Jul 12**	**0 Many Days**

Max daily outflow is river release only. Max release to canal was 425 cfs on 6 Aug 04. No min required release.

SWANSON LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



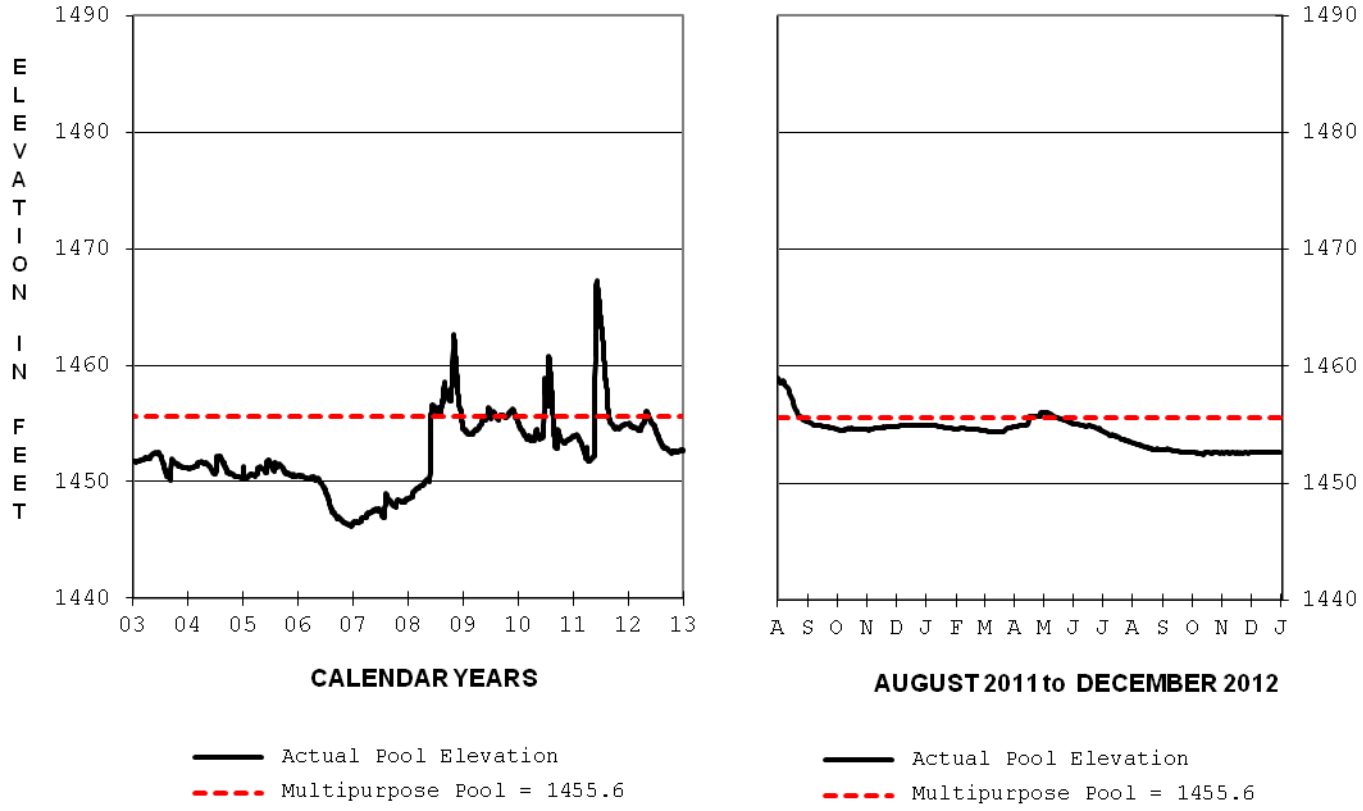
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2742.61 1 Aug 11	**2732.41 31 Dec 12**	**2744.03 5 May 12**	**2732.35 13 Dec 12**	**2757.40 3-4 Aug 62**	**2724.30 26 Aug 02**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
460 13 Apr 12	**28,516**	**262 17 Jul 12**	**1 Many days**

Maximum daily outflow is river release only (mostly seepage). No releases from canal. No min required release.

WACONDA LAKE
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



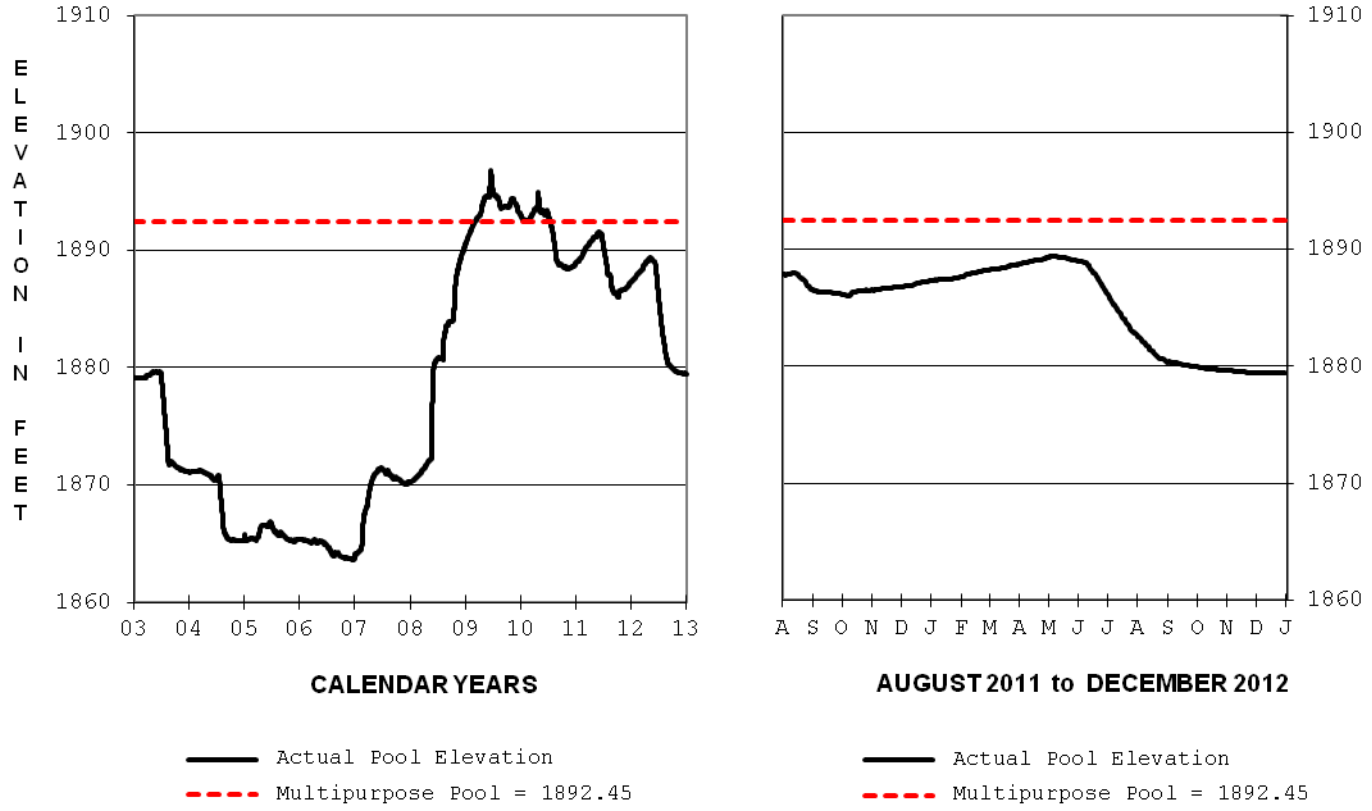
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1458.98 1 Aug 11	**1452.66 31 Dec 12**	**1456.01 1 May 12**	**1452.44 12 Oct 12**	**1487.02 29 Jul 93**	**1446.18 19 Dec 06**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,500 6 Aug 11	**189,090**	**1,501 Many days**	**9 10 Nov 12**

Max daily outflow is river release only. No min required release, but min mean monthly flow of 24 cfs is desirable.

WEBSTER RESERVOIR
2011 - 2012 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1897.94 1 Aug 11	**1879.43 31 Dec 12**	**1889.41 5 May 12**	**1879.41 14 Dec 12**	**1907.04 5 Jun 95**	**1857.35 22-29 Oct 71**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
250 11 Oct 11	**20,479**	**165 27 Jun 12**	**0 Many Days**

All releases to river. Max daily outflow occurred as part of normal irrigation releases. No minimum required release.